AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 7, No. 11. WEEKLY. | NEW YORK, MARCH 15, 1884. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

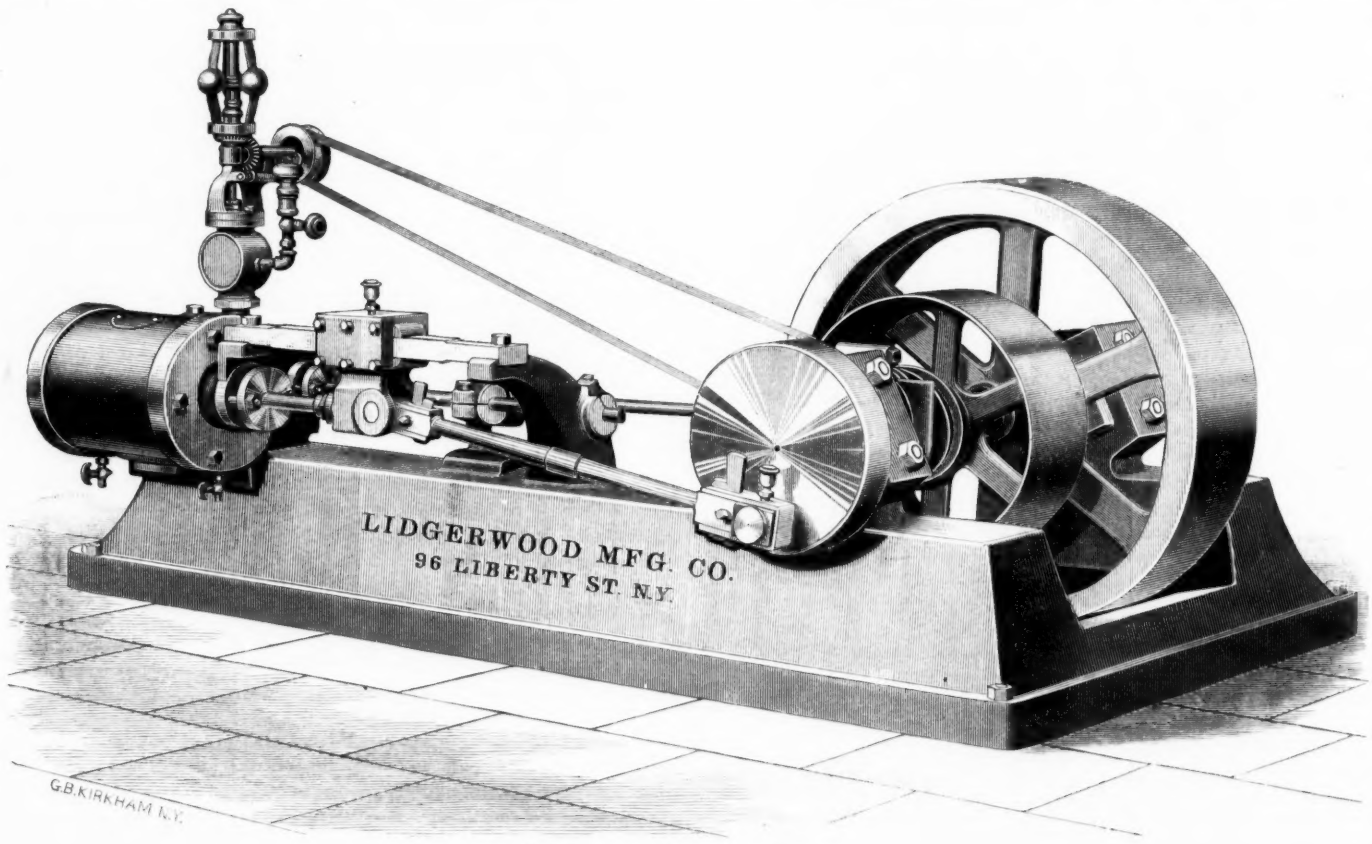
COPYRIGHT, 1884, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Lidgerwood Horizontal Engine.

For some time back the Lidgerwood Manufacturing Company have experienced considerable demand for a first-class plain slide-valve engine, made as carefully as the average automatic engine. To meet this demand they designed the horizontal engine shown in perspective in the engraving. It is constructed upon a box bed-plate casting of L shape, so as to include the outside bearing of the shaft, and the whole engine complete in one piece. It also has taper sides of great depth, with broad base, which secures a good margin of strength, with firmness and rigidity, that will ensure keeping the parts in perfect line, tending to provide a smooth and steady running engine. An attractive feature about the engine is its compactness and the get-atable arrangement of the working parts. Steel has been employed to a considerable extent in the construction of the engine, the piston-rods, valve-stem, crank-pin and cross-head being of that material. The crosshead is of the under-hanging form used so much with heavy locomotives, and has long rubbing surfaces connecting with the guide by composite gibs. The main rod ends are made with straps held with keys, all being substantially made and well fitted. The engine is supplied with a good governor, and has a full set of lubricating cups. All the parts are made interchangeable.



LIDGERWOOD HORIZONTAL ENGINE.

The makers of the engine claim that this form is especially adapted for places where it is inconvenient to erect a solid foundation. It will run well and give entire satisfaction when erected upon ordinary floors in buildings, or set upon timber foundations. The engine is built and sold by the Lidgerwood Manufacturing Co., 96 Liberty Street, New York.

The committee of the Master Mechanic's Association have issued a circular asking for information about the value of different forms of wheels, as demonstrated by the experience of those who have used various kinds. Questions are asked as to the number of all kinds of wheels used and the service they have given. Master mechanics are requested to state if they have had any trouble with tires coming loose or breaking, and to what extent in proportion to the number in use. They are also asked what kind of wheel they consider safest for engine and tender use.

Mild Steel in Boiler Construction.

BY GEORGE MARSHALL.

SECOND PAPER.

In my last paper I gave to your readers a partial account of the mysterious action of the steel plate in the boilers of the yacht Livadia, and promised a continuation of the subject in this paper. Perhaps it may not be of interest to all of your readers, yet on the supposition that it will be of interest and importance to many, I will continue the subject. The plades referred to were made by the "Siemens' process," tested at the mill before shipment, and of 219 tests made the entire number were satisfactory and fully up to the specification, which required that "each plate should have a tensile strength not less than 26 or more than 30 tons, and an elongation of 15 per cent. in a length of 6". Messrs. Elder & Co. also had check tests made which fully sustained the tests made at the mill. The shells of the boilers were to be of steel, the internal parts of iron. It appears that one of the plates fell from the slings during the punching process, and where it struck on a casting showed an indentation in the vicinity of which no crack was visible, but it had cracked at a number of the rivet holes. The steelmakers were communicated with, and one of the firm gave it as his opinion that the plate had been injured by the punching, and should be annealed to restore the material to its normal condition. This was done in the manner stated in the last paper and with the results shown. Various causes were assigned for the mysterious fracture—some suggesting too much silicon, sulphur or phosphorus, or that the carbon was too high, others that the steel was made by the Bessemer process and overblown, others that the material had changed its nature during the process of annealing, and had become brittle; while some few suggested that the process of punching and riveting had caused all the trouble. Chemical analysis and mechanical tests were resorted to, the first of these clearly proving an unequal distribution of the chemical properties, not sufficient in itself to account for the rupture while the mechanical tests showed that the tensile strength of the plates was not injured by punching to any greater extent than was usual in mild steel, but that the plates when punched became brittle for some distance from the holes. But the most important conclusion reached was "that the appearance of the fractures, especially in those samples broken by tension, showed that the material had not had sufficient mechanical work bestowed upon it, a number of minute laminations, cracks, and longitudinal splittings being distinctly visible in the specimens, and this defect, together with punching, made the material entirely unfit for employment."

This conclusion having been arrived at, and the blame being thrown on the steelmaker, gave rise to the question, "How much labor is necessary to produce the best steel?"

The makers of the steel stated that the ingots were not less than 12", and the recommendation was, I believe, finally made and adopted that steel plate should not be made from ingots unless the same were twenty times the thickness of the intended plate.

The principal object I have in giving so much space to this question is, first, to show how a matter of this kind is attended to by our English cousins, and how little attention it receives from us on this side of the ocean; and, secondly, to show how little is known on the subject of steel by the average worker of it in this country, and how much we are at the mercy of the mill-owners in buying what we suppose is a first-class article. This point being reached, I would reiterate the statement made in the early part of my last letter, "that the nature and properties of steel did not receive the attention they deserved," and the suggestion that societies should be formed for this purpose. The material in boilers built for marine purposes in this country must be tested by the U. S. inspectors, and a copy of the test furnished to the boiler builders. This report must show the thickness and width of sample; tensile strength, which must be the same as the plate from which the sample was taken; strain at which each sample parted; strain per square inch of section; reduced width and thickness and percentage of contraction of area. Records of each test must be filed in the inspector's office; and, in addition to the testing of the material, it is further the duty of the inspector, as often as possible, to visit works where marine boilers are being built, and see that the flat surfaces are sufficiently braced, that flues are made of proper thickness and form; in fact, to exercise a general supervision of construction, in order that the boiler, when completed, shall have the maximum of safety. This is not the language of the law, but is, I think, the intention and meaning of it. Experiments made by English experts show that the use of the American spiral punch gives an addition of 2½ tons to the tensile strength over and above the common flat punch.

In regard to the corrosion of steel and iron when used together, I will now give the experience of a steam user in England, who had a Lancashire boiler built sixteen years ago, one of the flues of which was iron and one of steel. The plates were punched throughout, and for years a careful watch was maintained to see if there was any difference between the two metals, but it was finally abandoned, as nothing could be found to show which was iron and which was steel.

Having given your readers a partial account of the most mysterious fracture of steel yet recorded, I will in addition say, this was in Scotland. From what I can learn from reports of societies and individuals, I fully believe that the steel made in this country is far superior to that made in England, Scotland, or France. I believe it to be more uniform in its nature, and possessing far better

qualities than that used in the Livadia's boilers. That such is the case is no reason why we should not devote more time and study to the subject than we have done, as the lives and property of so many are involved in the proper construction of a steam boiler, and a proper understanding of the material we use.

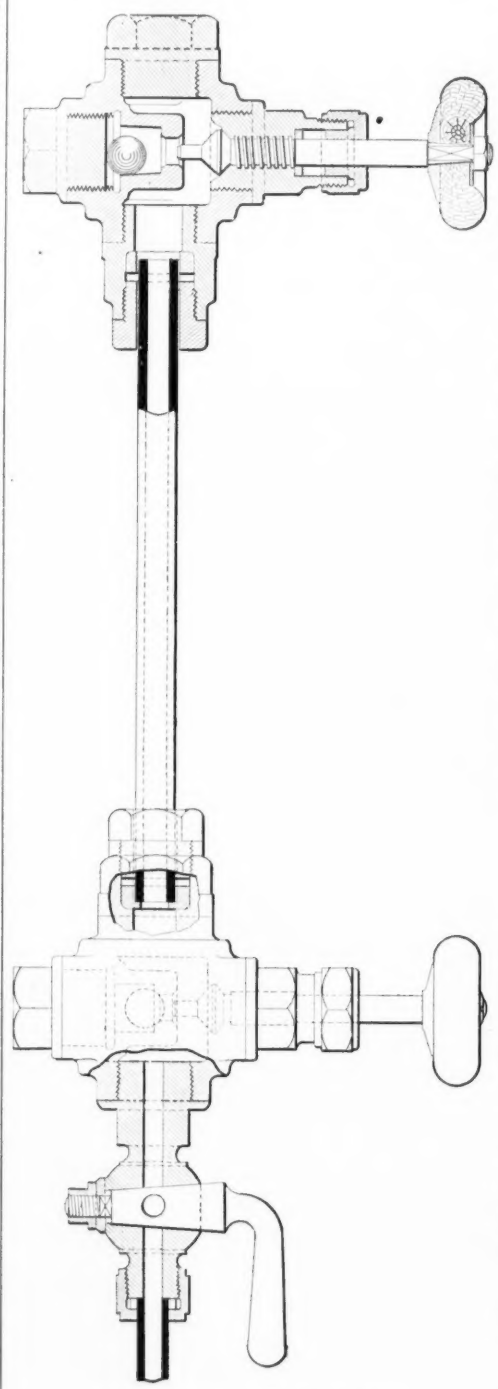
Insurance inspection companies are more numerous in Great Britain than with us, yet I think the percentage of explosions is fully as great on that side as on this. Too much care cannot be taken in the manufacture and use of steam boilers, and for this reason there should be a general law for the proper inspection of boilers, either by locally appointed inspectors, or else by responsible insurance companies. If State or county inspectors were appointed, they should be selected for the knowledge they possess of steam and steam-boiler construction, not for any political influence. As a rule, the insurance companies will appoint competent inspectors, as with them it is a question of dollars and cents, and where the pocket is interested watchfulness and care are generally the result.

My own experience with steel plate justifies me in saying that it can be, and sometimes is, made too hard for manipulation by the ordinary boiler maker, and great care must be exercised to insure the best results. This care and knowledge can only be acquired by patient study and close attention to the nature of the different brands of steel used in the construction of boilers, and usually more valuable information can be obtained from the foreman of a boiler shop as regards the proper quality of material required in a boiler, than from any experimental tests which I have yet seen reported. The reason of this is obvious. A man of large experience knows by that experience what brands of steel or iron have given him the best satisfaction in working and durability, while tests are generally made from selected stock, and the best results only are published.

From a correspondent we learn that several changes have lately been made in the mechanical department of the southern part of the Bee Line, which have given much dissatisfaction. The company has been following a cutting-down policy, every man who could be spared having been discharged. This extended to several master mechanics, whose services were dispensed with, and foremen promoted to do their work without any increase of pay.

The Player Water Glass Cocks.

An important attachment for a locomotive boiler head is a good set of water glass cocks. Although the safety of a boiler is seriously jeopardized by defective water glass cocks, many very inferior sets are in daily use, a fact which has much to do with the want of confidence exhibited by many engineers towards water glasses generally. When a glass gauge is right, and is kept in proper order, it is the best kind of indicator as to the condition of the water. When an engine starts foaming, or the steam begins to raise the water badly, the condition of the boiler can be readily perceived by a water glass and dangerous consequences avoided. Men who have got accustomed to water glass gauges, and appreciate their advantages, generally retain one objection to their use in so far that they are liable to break at an inconvenient moment when the rush of escaping steam and water may prove a source of danger. In the water glass cocks shown in our engraving, this source of danger and annoyance is eliminated by the use of an automatic closing valve. This form of water glass cock is employed exclusively on the engines of the N. Y., West Shore & Buffalo Railway, and they are very much liked by the engineers. As no other gauge cocks are used, they have to depend entirely upon the glass, and the men consider it safer than gauge cocks. The automatic closing arrangement is very simple. In the steam and water passages from the boiler a small chamber is provided, where a brass ball is inserted. During ordinary working the ball rests clear of the opening, as seen in the top fitting. When the glass breaks and a rush of steam takes place, the ball fills the opening, as seen in the lower cock, and prevents all leakage. The device is simple and effective. It was invented by John Player, mechanical engineer of the road, but is not patented, so any master mechanic or boiler-user can adopt this form of water glass cock without being called on to pay a royalty.



THE PLAYER WATER GLASS COCK.

Car Builders' Club Meeting.

At the monthly meeting of the New York Master Car Builders' Club, on the evening of February 21, a paper was read on "Uniformity in Car Construction and Railroad Equipment." The writer of the paper expatiated on the advantages that had been derived by railroad companies from the advances made towards uniformity in rolling stock construction, and dwelt upon the desirability of still making improvements in that direction. There were great difficulties in the way of getting master car builders to agree upon a standard car, but the advantages to be derived from such a standard would be so great that no effort should be spared to forward the matter. In regard to the influence that the agitation in favor of standards had exerted, an iron manufacturer present remarked that formerly they were not at all particular as to exactness in rolling iron bars, one thirty-second inch outof size being considered close enough for all practical purposes. This was now changed, and to adapt themselves to the demand for exactness they had to adopt steel rolls, and measure their output with accurate gauges. Under the new conditions, they turn out bar iron perfectly uniform as to size. A member of the club thought that such parts as axles, oil-boxes, brake-shoes, draw-heads, etc., of a car should be interchangeable, but he had no expectation that the master car builders would agree upon standards for these articles, and he thought that the higher powers in railroad management should interfere to urge on this desirable reform. The meeting generally favored the adoption of a standard for all parts of passenger and freight cars, but they did not seem hopeful that the change would be made soon.

The days of the ground mouse, which Burns sings so pathetically about, and of the versatile gopher, and weather-predicting ground-hog are numbered. These pests of the farmer undermined the young corn and burrowed in the flowery meadow since agriculture began, and all the attempts of the gardener to displace them have proved futile. Mechanical invention and physical science now threaten to root out these burrowers from their underground resorts. An inventor has obtained the influence of the United States Patent Office to protect his interests in a torpedo, with which he means to exterminate the whole race of ground-burrowing animals. The process is perfectly simple. An exploring party finds all the holes leading to the nest of the offending quadruped, pounds them all air-tight except one, into which a charge of dynamite is inserted. A fuse is connected with this, a match applied, and the party is ready to search for the next burrower, unless the explosion makes a mistake and demolishes some of the hunters, instead of the animal.

Working Men's School.

We recently enjoyed a pleasant visit to the Working Men's School, at West Fifty-fourth Street, New York, conducted by Professor Felix Adler, and we think the supporters of that institution are aiding a valuable educational work, which deserves extended encouragement and support. The children attending this school are educated with a view of preparing them for the industrial occupations by which it is expected they will gain their future livelihood. Even the youngest of them are trained to the use of tools, and by the time they finish the course they receive sound instruction in applied mechanics, in forming geometrical figures, and in drawing.

In an upper room we found a crowd of children, ranging from six to ten years old, sitting at benches cutting rectangular blocks from plastic clay by means of a square and knife. The teacher gave directions to lay out a rectangle 4″x2½″, and most of the children made the measurements tolerably correct. Then they proceeded to cut out the block to the shape indicated, using the square to prove that they were cutting at right angles to the surface. Some of them made a fair job, and all of them displayed familiarity with the method of working correctly. As they advance they get more complex figures to make, and are made familiar with calculations by concrete operations. From clay moulding they proceed to cutting figures in pasteboard, and further on they saw them out of thin wood with a jig saw. In the lower part of the building there is a neat, well-arranged workshop, fitted up with lathes and other tools, where the more advanced pupils work during a part of their school hours. This industrial instruction is merely in connection with a regular scholastic course, but all instruction is directed so that the pupils will perceive its application to practical work.

By a letter from Mr. Ives, general superintendent of the Burlington, Cedar Rapids and Northern Railway, we learn that that company are experimenting with the Hotchkiss boiler cleaner to try and abate the trouble they have from lime deposits in the boilers of their locomotives. Mr. Ives also mentions that the ten-wheel locomotives, which they recently received from the Pittsburgh Locomotive Works, are doing from 30 to 40 per cent. more work than their eight-wheel engines, with a very small increase in running expenses. Before the ten-wheel locomotives referred to were received, the company employed eight-wheel engines exclusively for operating all kinds of traffic.

Improved Glass Valve Wheels.

Those who have had experience in the use of the ordinary wooden wheels on valves and other steam fittings will not need to be told of their weak points, and will also appreciate the substitute illustrated herewith. It consists of a glass disk, in shape substantially like the wooden disk, but without the propensity of the latter to split, get dirty and come loose in its mountings. This glass disk being a non-conductor of heat always remains cool to the touch, and retains an untarnished surface. Being thoroughly annealed it will stand rough usage, and can be readily replaced if required. It is made with a square recess on the back side, for a square iron washer, through which is a square hole fitting a squared section of the stem; thus providing against the possibility of the disk turning on the stem. A recess on the front admits a round washer and the screw head which holds the disk on the stem, the metallic parts are so situated that the hand does not come in contact with them. These disks can be taken off and put on almost instantly, so that for heating pipes they can all be left off until the job is completed, thus preventing tampering with the pipes when the job is in progress. They are made by Pancoast & Maule, Philadelphia, Pa.

The First American Iron Planer.

A prominent machine tool maker, who is very well informed about everything connected with his trade, informed us that Thos. Hill, of Providence, R. I., constructed the first iron planer made in this country, and we published the item mentioning that fact. Mr. Hill now informs us that this is a mistake, and that Edward Bancroft, of Providence, made the first planer when he was engaged in plow making. This was about 1830, when there were no regular tool makers in the country, and any shop large enough to do the work got out a lathe or other tool when they felt assured of getting them sold, just as shops having no intention of going regularly into the business got out a locomotive occasionally. Mr. Bancroft, maker of the first lathe, afterwards entered into the firm of Fairbanks, Bancroft & Co., and they went into the work of building steam engines in Providence. He afterwards withdrew from this connection and, in company with his nephew, Wm. Sellers, started the firm of Bancroft & Sellers, and commenced making machine tools in a shop at Kensington, near Philadelphia. At his death the present firm of William Sellers & Co. was established, and the works were moved to Philadelphia.

The Texas Pacific Railroad Company has decided to build a round-house at Dallas, Tex., of stone and iron, to accommodate nearly thirty locomotives. The company has purchased a tract of land in Dallas for $50,000.

Houston, Tex., has a rolling mill that turned out its first bar of iron January 31.

The Kilmer Wire Band Manufacturing Company, Schenectady, N. Y., have opened a branch office at 160 Sherman St., Chicago. This company manufacture galvanized wire bands, cable fence wire, and ornamental fencing. The prospects for an enlargement of their works to meet increasing demands are good.

How to Strike up a Propeller Wheel.

BY ISAAC WHITEHEAD.

Propeller wheels made in England for ocean service are almost invariably struck up, and it would be difficult to find a pattern in Liverpool at the present day. For a pattern maker to make the necessary strikes, templates, &c., intelligently, he, as well as the moulder, must know how the mould is constructed. The fact is, the moulder and the pattern maker are partners in making any mould, and therefore the moulder must not consider me as intruding upon his trade, if I step in and run the constructing of moulds once in a while in the interest of pattern making. In the construction of moulds, the pattern maker should be better informed than the moulder, if it is possible, because he must decide how it is best to mould a pattern before he makes it. Therefore the pattern maker should be equally competent to discuss the construction of moulds with the moulder, though this is not generally the case.

To illustrate the method usually adopted to strike up a wheel, let us take for example a wheel eight feet diameter and nine feet pitch, with four blades.

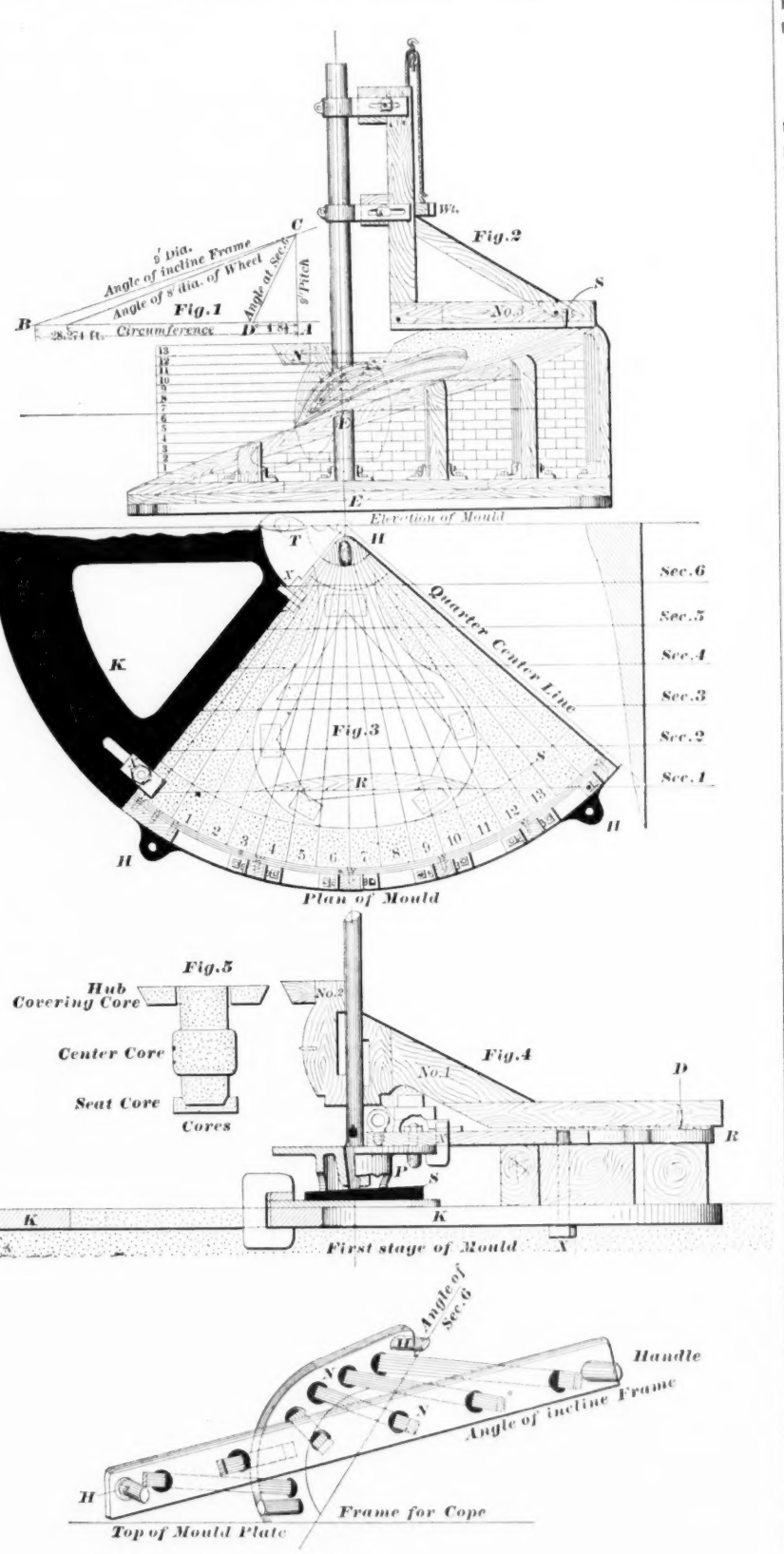
The pitch of a screw is the travel made by a point on its surface, in line of its axis, by one revolution.

To ascertain the angle at any point on the face of the screw, construct a right angle, the base of which shall be the length of the circumference described by that point in revolution, while its perpendicular height shall equal the pitch. For this case we will fix upon a point 6″ outside the periphery of the wheel, which would make a circle 9 feet in diameter, at which point we will erect the inclined plane, as shown in elevation Fig. 2. The circumference of a 9 foot circle is 28.274 feet, therefore we will lay off on the line *A B*, Fig. 1 (at any scale), say at $\frac{1}{8}$″=one foot, 28.274-eighths; and on the perpendicular *A C* 9-eighths; connect *B* and *C*, when *C* will be the angle or incline on the circumference of 9 foot circle for 9 foot pitch. Take the point of section 6, Fig. 3, in center of blade which is 18″ diameter, and it equals 4.7 feet in circumference; lay off 4.7-eighths on *A B*, Fig. 1, and connect *D C*, which is the angle at section 6 for 9 foot pitch.

To make this frame lay off the arc of a 9-foot circle, Fig. 3, and nail up in segments of two layers for base; erect posts allowing them to be high enough to take the greatest pitch you may require within the range of 8 feet and under. Screw upon the inside of the posts two or three thin strips in layers that will easily bend to the circle, rising at the same rate per foot on the circle as the angle *B*, Fig. 1. Adjustable cast-iron stands might take the place of the posts, but the latter is much cheaper and lighter, and will last a long time. Three or four sizes of frames would be all that would be needed to make all sizes of wheels; as, for instance, this frame can be used for all wheels less than eight feet in diameter.

The first requisite is a circular base plate; the one, as shown in part, in Figs. 3 and 4, marked *K*, is a good one for the purpose. Next, I would call attention to the center that holds the spindle, as it is a very useful one for many purposes where striking is done. The flanges upon it are both the same diameter, so that it can be easily rolled from one place to another; the bore is a slight taper, holding the spindle firmly, so it can easily be taken out by the wedge *S*. Thus the work is raised about 12″ high, so that a man can get underneath to fix anything he may need. Instead of the wood blocks shown, to level up the mould plates *R*, Fig. 4, cast stands might be used. Four holes are spaced equally on the top flange, as shown at *T*, Fig. 3, to receive the dowel in mould plates, as shown at *P*, Fig. 4. After laying down the four plates, adjust strike No. 1, Fig. 4, strike off a bed for the inclined frame, and also a seating for the hub; the scriber *D*, marking off the inside edge of frame, or nine foot circle. Mark the center line of blade upon the arc described by *D*, so that it will place the blade in the center of the plate, though the blade may be largely on one side of its own center. Place the inclined frame to the arc, with the center *E* on frame on center line of blade. Strike No. 2 for the hub is then set to the seat struck, and also No. 3 strike is put in place, as shown in Fig. 2. The mould is now bricked up to the strikes, allowing thickness for loam, as No. 3 strike is worked upon the inclined plane and the hub is worked round the spindle. When the face of the mould is set, mark upon it the center line *E*, and the periphery of the wheel, as shown by marker *S* in Figs. 1 and 2.

To lay out an outline of the face of the blade and sectional lines 1, 2, 3, 4, 5, and 6, Fig. 3, a light frame is made, say $\frac{1}{8}$″ thick, of the shape required, an idea of which is shown in Fig. 3, as it would lie in its position on the mould, upon which the lines are transferred.



Section strips are next required. They are made about $\frac{1}{2}$″ thick, and laid out in the same manner as shown in the case of laying off sections for wood patterns, each having a center line upon it. Section 4, Fig. 3, would appear, when developed, something as shown by *R*, Fig. 3, having a curved face. Each section strip is placed upon its line on the mould, and the spaces between these thickness strips are filled in with green sand, which is shaped by easy curves to the required form of the blade, as shown in Fig. 2. Next is put on the cope, made as shown in Fig. 6. Two pieces are cast, like *N* and *N*, about $1\frac{1}{2}$″ thick, and the same number of round holes in each, about 2″ in diameter. Square, open sand-bars are cast, about $1\frac{1}{4}$″ square, and threaded through *N* and *N*, as they lie in their place on the mould, and then fastened with iron wedges in the holes on the side of the bars. Bricks are fastened in between these bars as the cope is rammed up, then the cope is lifted off by the four corners, as shown. The thickness strips and green sand are then taken off the face of the mould, and the mould lifted by the eye-bolt and lugs *H H H*, Fig. 3, placed in the oven and dried. When dry, the mould is put together, and bottom plates made fast to base plate *K*, as at *X X*, Figs. 3 and 4. The spindle is taken out, the bottom of hub filled in, and a seat core, as shown in Fig. 5, is bedded in place. Then the center core is put down and the hub-covering core last of all. Now the mould is ready to be prepared for casting.

The variations in shape, that can be struck up, are:

1. In the pitch.
2. By setting strike No. 3, Fig. 2, at any angle to the spindle, thus throwing the periphery of the blade fore or aft.
3. By shaping the outline of the blade, and thus changing the areas in different relations to the center lines.
4. By curving the edge of strike No. 3.
5. Variations have been made by bedding a strip of wood at Sec. 6 in the mould, at a different pitch from the outside frame; and, instead of using strike No. 3, use a straight strike upon the two-pitch surfaces, keeping it on a level plane.

The advantages claimed for strikes over a pattern are:

1. A sounder face, by its being cast down.
2. Truer, because of the imperfections of a pattern, as well as its swelling in the damp loam and thus changing its shape.
3. Less work to command a great variety with little pattern storage.

The advantages of a pattern are, cheaper moulding and the ability to adopt eccentricities of shape of face.

Frederick Fladd, Middletown, Conn., wants to obtain a copy of No. 3, volume I., AMERICAN MACHINIST. Can anybody supply him? He will pay $1.50 for a clean copy.

Increasing the Navy.

A bill has been introduced into the Senate authorizing the President to have seven steel vessels constructed for the navy, besides one steel ram, one cruising torpedo boat and two harbor torpedo boats. Of the seven vessels, two shall be cruisers of 4,500 and 3,000 tons respectively, one a dispatch vessel of 1,500 tons, two heavily-armed gunboats of 1,500 tons each, and one gunboat not to exceed 900 tons—all to be built on plans and specifications to be furnished by the admiral of the navy. We do not share the desire expressed frequently by many journals to see an expensive navy built to rival in magnitude the navies of Europe; but we think the country should maintain enough first-class vessels to form the nucleus of a navy should a necessity for coast defence be forced upon us. If we are to build additions to the navy, the work could not be undertaken at a better time than the present, when building material is cheap, and there is money to spare for the purpose. While the building of additional vessels for the navy is under consideration, it would be a good plan to arrange for building some vessels of the Ericsson Destroyer type, illustrated in the AMERICAN MACHINIST of September 24, 1881.

The advent of the electric light has given us a good many "electric light" products. We have electric light engines, electric light governors, oil, belting, &c. Most people will incline to the belief that any of these products that are used in connection with electric lighting will be found good enough for some other purposes.

Offering Prizes for Inventions.

The *Cincinnati Artizan* notices the fact that a French society has offered prizes for certain inventions, and encourages its readers to try for them. The first prize is $600 for a new method of producing cast iron or steel having properties of special value; the second prize is $400 for the best machine for cutting the teeth of spur-wheels and for finishing the different parts of small arms. There are several other minor prizes of $200. This thing resembles the prize offered some years ago by the Humane Society for a stock car with certain valuable features, which turned out a complete failure. Offering prizes may direct attention to the subjects for invention, but any inventor, producing what is sought for, would have a valuable property that the patent laws would protect, and which would be likely to yield a much greater return than the prize money offered.

The next regular meeting of the American Society of Mechanical Engineers will be held at Pittsburgh, Pa., May 20. The society is in a very flourishing condition. Between thirty and forty candidates for membership have applied since last November meeting, and other applications will be received before May 20.

The Indicator Diagram.

By F. F. Hemenway.

DIAGRAMS FROM A COMPOUND ENGINE.

Some weeks since extracts were made in the American Machinist from a letter written by William Coutie, of Troy, N. Y., having reference to compounding a pair of non-condensing automatic engines by adding to the plant a low-pressure engine to take steam from the two high-pressure cylinders. Figs. 7, 8 and 9 represent diagrams from these engines; Figs. 7 and 8 from the two high-pressure cylinders, and Fig. 9 from the low-pressure cylinder. The low-pressure engine is quite distinct from the high-pressure, and runs at a different speed. There is no receiver, except an extra large steam chest on the low-pressure cylinder. The high-pressure cylinders are each 18″x42″, and the low-pressure cylinder 40″x42½″. The high-pressure engines run at a speed of 83 revolutions per minute, and the low-pressure at 88 revolutions.

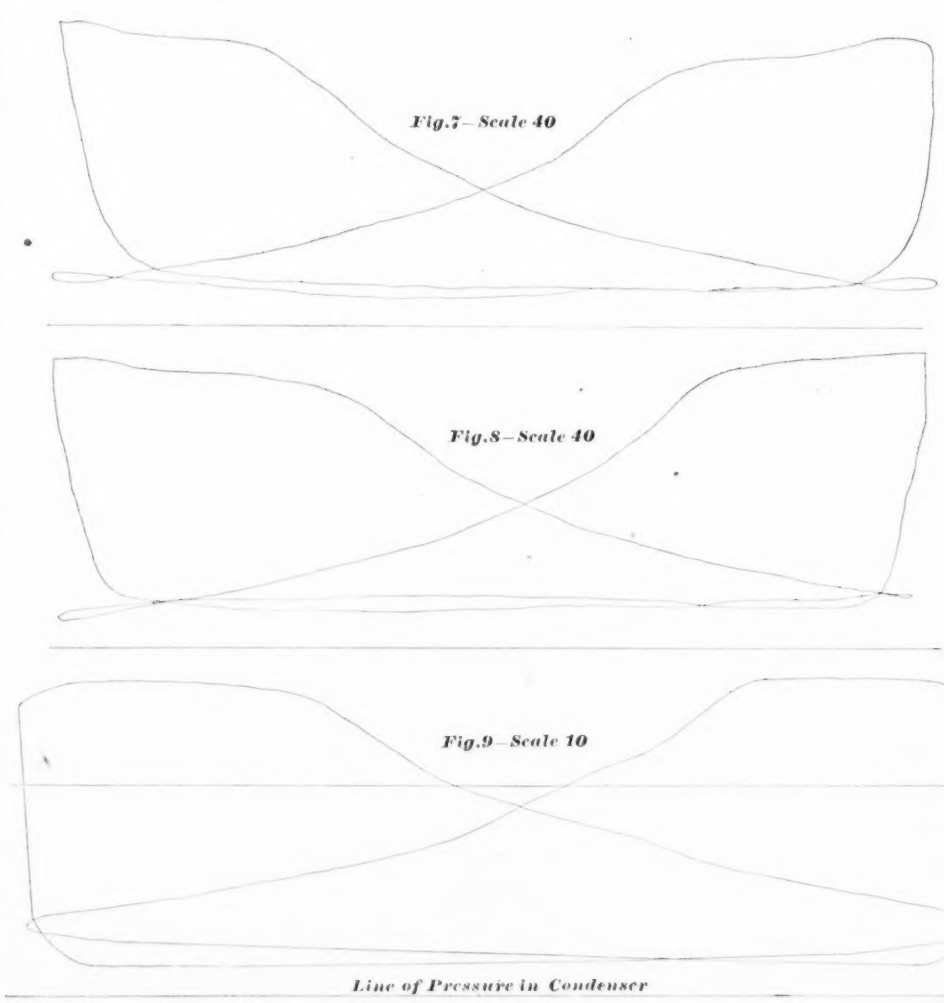
The high-pressure diagrams show an initial pressure nearly equal to boiler pressure (65 pounds), which, owing to the piston speed, falls off considerably before the point of cut-off is reached. In fact, the points of cut-off cannot be located with any degree of accuracy. The lead is unequal, and rather excessive, although it brings about a little higher initial pressure than would otherwise result, and probably does no particular harm if it results in smooth running. The points of exhaust opening and closure, also, are not alike. The time of exhaust opening can be seen on the diagrams in Fig. 7, being indicated by a change from the direction of the expansion lines, the pressure in the cylinder rising instead of falling, as is usually the case when the exhaust valve opens. This is due to the pressure in the steam chest of the low-pressure cylinder being higher, at just this time, than the pressure of the expanded steam in the cylinder. The variation in pressure of the steam in the low-pressure steam chest accounts for the unevenness of the lines of counter-pressure on the high-pressure diagrams. These diagrams, especially those in Fig. 8, show that the cut-off is not very well equalized. If steam had been worked alike in both ends of the cylinder the expansion curves would have crossed each other mid way of the lengths of the diagrams, an end more nearly attained in Fig. 7 than in Fig. 8.

The diagrams from the low-pressure cylinder show very straight steam lines, and a little inequality as to the amount of work done in the two ends of the cylinder, in the lead, and in the amount of the back pressure. Of course, if thought desirable, the lead could be readily equalized as well as the cut-off, which is equally true of the high-pressure cylinders. The difference in back pressure, between the two diagrams, is more apparent on account of the low tension of the spring used in the indicator. It really amounts to less than ½lb.

In respect to hastily observing diagrams, it should be noted that in those taken with a spring of low tension, variations in the lines appear magnified to the eye, since diagrams are commonly taken with springs of comparatively high tension, and the eye becomes educated to read them on this basis. In the instance of these diagrams a variation of one pound pressure is represented by $\frac{1}{10}$ of an inch, which is a very noticeable variation.

The mean effective pressure (average of both cylinders), of the high-pressure diagrams is 23.8 lbs., and the horse-power 212.8. The mean effective pressure of the low-pressure diagrams is 8.62 lbs.; horse-power, 204.5; total horse-power developed, 417.3. It is interesting to determine just how much the work done is increased by the addition of the low pressure engine. If it is assumed that the average back pressure of the high-pressure cylinders exhausting the quantity of steam used into the atmosphere would be one pound, the loss of mean effective pressure in these cylinders due to exhausting into the steam chest of the low-pressure cylinder is 7 lbs., equivalent to 62.5 horse-power, the remainder—142 horse-power—being the work done by the low-pressure engine, without any cost in steam. This is not giving the low-pressure engine all the credit due it, because the higher pressure of steam in the high-pressure cylinders during the period of exhaust keeps them hotter, and reduces the inevitable loss from condensation.

It has been previously remarked that it was essential to know the pressure in the condenser, in order to determine how much back pressure to charge against the cylinder. This is particularly important in this instance, since the condenser and air pump were no part of the low pressure engine, but were quite independent, located more than 50 feet away (measured by the length of connecting-pipe, and some distance higher than the cylinder. The exhaust from the engine passes from the cylinder down to a heater 30″ diameter and 16½ feet long, then from this heater up and to the condenser. The vacuum gauge on the condenser showed a vacuum of 23 inches, or a pressure of 3.4 pounds, as represented by the line on the diagrams. Measuring from this, the back pressure which the engine is responsible for is only 2 lbs. The heat extracted from the exhaust steam in the heater referred to is used for heating water to be employed for various purposes in the mill, and it is to be presumed that the loss from impaired vacuum is more than made good by the heat saved in this way.



A Risky Ride.

A young man who stole a ride on an English railway train recently, adopted a plan which was quite original. He tied a rope to the bottom tie braces of a coach, and suspended himself in this position so that he was able to ride a distance of 200 miles from Liverpool to London. On reaching the latter city his position was discovered, and he was promptly arrested. When brought before a magistrate the ride-stealer admitted that he got terribly frightened after the train started, but as there was no stoppage he was compelled to hang to the brace or be cut to pieces. The magistrate considered he had been sufficiently punished for the offence.

Draft-Regulating Appliances of Locomotives.

By J. Dugald Campbell.

FIRST PAPER.

My earliest recollections of complaints about locomotives were that they steamed badly, a complaint which is not to be wondered at, considering the amount of steam that a locomotive must generate to do its work. When we hear this complaint made, our natural tendency is to reflect on the many causes that are apt to prevent a locomotive from steaming freely, and to try to find out which of them are operating in the case under investigation. In the wood burning times the troubles with locomotives steaming badly were rather more numerous than they are to-day, and the cures resorted to were legion. One of the supposed remedies was to alter the cone in the stack by increasing or decreasing its diameter; and another and more frequent remedy was to bush the nozzle of the exhaust pipe by putting in a copper ferrule. That was the everybody-remedy. Another resort was to alter the lift-pipe in its diameter, or by running it up or lowering it. The real cause that prevented the making of steam freely was most frequently the partial stoppage of the netting with soot, and the use of green cord wood. After this came defective methods of firing. Attention was seldom paid to the best mode of placing the wood in the fire. The fireman's pride was in the ability to throw a stick into the fire from the rear end of the tender. The result was that wood was thrown into the fire-box without regard to its size, shape, or quantity. This careless firing allowed a large quantity of cold air to enter the fire-box between the sticks, and the engine would not steam.

When the remedy of bushing the nozzles was resorted to it only aggravated the evil by sharpening the blast, and causing more air to pass through the wood. But somuch depended on the quality and size of the wood, and on the manner of placing it, that what might be a cure for bad steaming to-day increased the trouble to-morrow.

With the advent of the coal-burning locomotive, the conditions were somewhat changed. As far as the fuel was concerned in regard to its position in the fire-box it became a constant, and its quality nearly so. The effect of any change in the draft arrangement could now be observed with less liability to error through fault of the firing, or through the quality of fuel. The lifting-pipe, as an aid to draft, was still retained in the smoke-box. But there being no necessity for the stack to form a reservoir for holding the sparks, the large stack was abandoned and straight pipe, with an enlarged top to admit of sufficient area for netting, and a cone to protect the netting from the effect of the sharp exhaust, were substituted. This was called the "diamond" stack.

It was supposed, and is still, by many, that the shape of this diamond stack was of importance in aiding the locomotive to steam, and that the same was the case about the shape and diameter of the cone. This is a fact, to a certain extent, in that the angle of the side and the flare of the cone should be such in their relation to the sides of the diamond top, that when the exhaust struck the cone and was deflected on to the sides of the stack it should impinge on the lower angle of the diamond, and at such an angle as would cause it to easily deflect on to the upper one, and then make its escape cleanly, without leaving the diamond filled with straggling steam.

The height of the stack from the rail being limited, and an inside pipe of sufficient length required, it follows that the length of the diamond would be limited, and that increasing its diameter would make the angles of the stack top too acute, and the exhaust would have to make an angle proportionally acute in its outward passage.

It is found that the diameter of the cone should be no larger than that required to protect the netting from the exhaust, and that in a properly constructed stack a diameter of 4″ larger than the inside pipe will cause it to serve that purpose. The top of the cone, or rather the inverted base, should be made with an easy flare to cause the exhaust to deflect outward and upward on the sides of the diamond. A leading aim in constructing the stack should be to avoid causing the exhaust to make an acute angle in its passage to the atmosphere. When it does so, or strikes too close into the corner of the diamond, the exhaust steam becomes confused or straggling in its passage, and much will remain to be driven out by the following exhaust. The failure of the exhaust to clear itself, may frequently be remedied by lowering the cone on the braces, thereby causing the exhaust to strike lower in the stack, thus avoiding striking on to the corner of the diamond, or on to the upper half, and deflecting back on the lower half of the diamond.

From this we may conclude, that while the diamond top of the stack is not one of the appliances used to cause a locomotive to steam, it will, if not properly constructed, be a preventive of easy steam making. That in the construction of the stack attention should be given to the inverted cone as a protection to the netting, in its diameter, in the angle of its sides, and regarding the flare of the base, so that it will allow the proper deflection of the exhaust on to the sides of the diamond. That the diamond shall be made to allow a clear and easy escape of the exhaust. That the angle and flare of cone, and angle of the diamond have a fixed relation to each other, and that they should be constructed so that the angle of deflection of the exhaust should always be upward and outward.

Apprentices in the Brooks Locomotive Works.

The apprentice night school connected with the Brooks Locomotive Works, Dunkirk, N. Y., about whose working we published full particulars on November 17th of last year, has proved so successful that Mr. Brooks has issued the following order which in future will regulate the hiring of apprentices:

"From and after January 21, 1884, apprentices will be admitted to service in these works under the following rules, and no deviation will be made therefrom: An applicant must possess a good moral character; must be 18 years of age, with a fair knowledge of the ordinary English branches of education, and write a legible hand. Applications must be made to the office in writing, and must be written by the applicant. An applicant must possess a natural aptitude for mechanics, and have a settled personal desire and purpose to become a skillful and competent workman. The term of service for apprentices will be three years. The compensation for the term will be: First year, 7½ cents per hour; second year, 9 cents per hour; third year, 11¼ cents per hour; ten hours constitute one day's work. Apprentices will be required to attend the night school such evenings in the week as may be designated for such purpose. Tuition and books are furnished free of charge, and from the date above mentioned attendance in the night school will be obligatory upon all apprentices who enter our service thereafter. Neglect of this privilege will be considered cause for immediate dismissal from our service. This company cannot guarantee continuance of service during the full term of apprenticeship, as the ability to do this must be regulated by the conditions of their business, but they will do the best possible for their apprentices.

"It is the intention of this company to institute a high standard of excellence among their apprentices. First, by refusing all unfit applications; and second, by using special endeavors to offer them every advantage to become not only skillful and competent workmen, but also to educate them in the principles underlying mechanical construction, and afford them opportunities to study and practice elementary mechanical drawing. Hence no applicant will be accepted until a full investigation of his character and elementary education is made. An applicant must be 18 years of age; must make application in his own handwriting through the mail, addressed to our office; and must be prepared to furnish credentials of his character, education, and aptitude for mechanical pursuits. Applications proving satisfactory upon investigation will be placed on file in the order of their application, and accepted applicants will be advised when their services are required."

Small Castings—The Mould Board and Flask Hinge.

BY THOMAS D. WEST.

For turning out small castings fast and neat, there is nothing more essential than having mould boards that will save hand joint making. There are used as common property four kinds of boards, the first being the wooden, the second the sand, the third the plaster Paris, and the fourth the match board, or plate. Making these is with some shops a common affair, while with others it is the reverse. There are many moulders, who, were they told to make a match plate, or plaster Paris board, could not do so without instruction.

At the left, in cut, is illustrated the making of plaster board. At the right is a section of the board as completed. In making this board the pattern is rammed up, and the joint made the same as if a cope was to be rammed upon it. Instead of the cope a sectional view of a wooden frame is seen, the inside of which is even with the inside of the nowel. The joint should be made tight, so as to prevent leakage. The plaster is poured in through holes, *K*, *K*, and when set the board is lifted off, and the sand washed off the face of the plaster with water and a brush. After the face is dry it is given a coat of lamp-black shellac varnish, and when dry the board is ready for use. In making plaster boards there are a few details which it may be well to notice. Plaster of Paris is made by boiling or burning gypsum, a mineral consisting, essentially, of sulphate of lime and water, the proportions being: lime, 32.56; sulphuric acid, 46.51; water, 20.93. Gypsum deprived of its water by burning, leaves a powder that, when mixed with its own bulk of water, forms a creamy paste which almost immediately becomes solid. In using plaster Paris the liquidity of the mixture should be regulated by the thickness of body required. For thin bodies two parts of water to one of plaster may be satisfactory, but for general work, one of plaster to one of water will be right.

In preparing to pour a plaster mould, the outside of joints should be either carefully stopped up with clay, or firmly banked up with sand, to prevent leakage. If nothing but the water comes out it is, of course, all right, for that is to be got rid of, and if it does not leak through the joints it is absorbed by the sand in the flask. The holes for pouring in the plaster should be as large as practicable, for the quicker a mould is filled the better for filling thin places or corners. If a mould has any body at all it will shrink, so as to require being filled up after it is poured. Before starting to pour a mould one should have plenty of water and plaster, for it don't work very well to have to run away from the job to procure either after a mould has been poured. With practice one can guess very nearly the amount of mixture wanted to fill a mould, and it should, especially for light body moulds, be all mixed before starting to pour. For thick bodies we may partially fill a mould, and then complete the job by a second pouring, but for general work plaster Paris requires prompt and active work.

The patterns used should be oiled, in order to prevent the plaster from sticking to them. In forming the joints special care should be taken, to insure that the mould board will form a joint that will not only lift clean, but one that will leave a finless and true jointed casting.

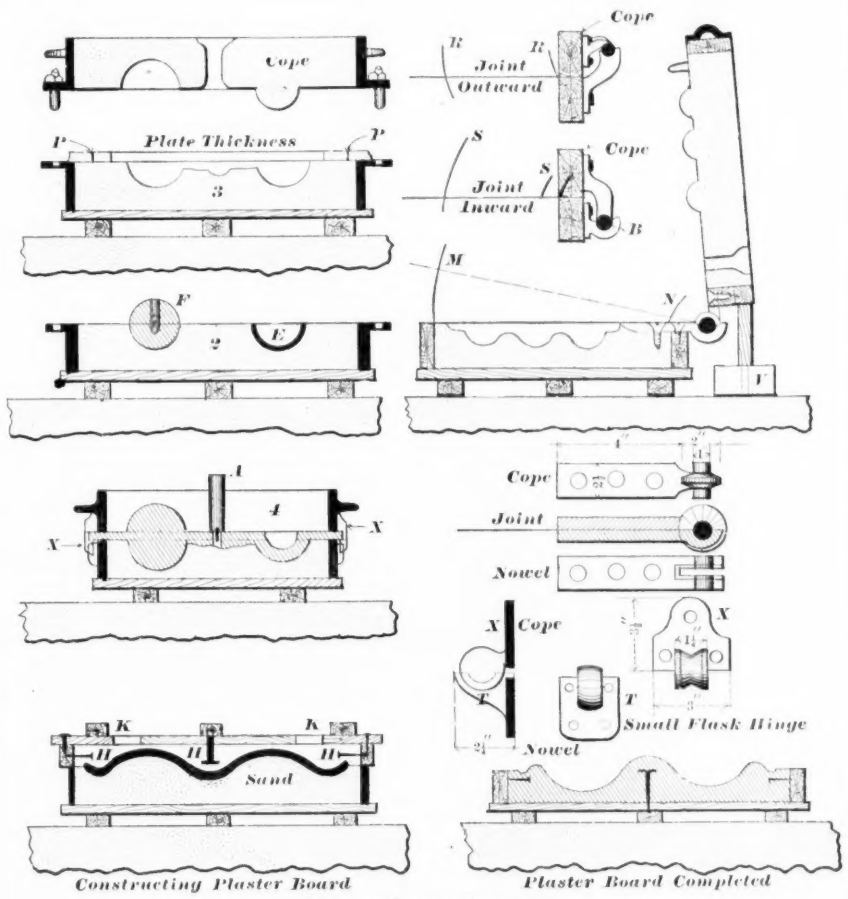
At *H*, *H*, *H*, are seen nails driven in for the purpose of assisting in holding the plaster in place. In some cases nails are driven all over the bottom boards, as well as at the sides of the frame. Again some will, where there are heavy bodies of plaster to hold, put in bars nailed to the frame, or secure to it strips or blocks driven full of nails.

Plaster boards are, ordinarily, used only where, from the crookedness of the pattern, wooden boards cannot be as cheaply carved, as perfectly fitted or kept as true when being used. Wooden boards, when of irregular shape and finely fitted, are preferred by moulders, as they are generally light, will retain good edges, and can be moved with little risk of being broken.

For irregular shaped patterns there is probably at the present time none more popular than what is called the "sand board." The common way of making sand boards is simply to ram up the nowel hard and solid, and then after making a good firm joint, ram up a false cope or frame. The kind of sand used for the boards has much to do with their life. Some take all new moulding sand, mixed with about one to ten of flour; others will use no flour, but will wet their sand with thick clay wash. Samuel L. Robertson, a man of large experience as manager and journeyman upon light work, informed me of a receipt for the mixture of sand for mould boards which he had used for making irregularly shaped patterns for Taylor & Boggis, Cleveland, Ohio. This firm is noted in this country and in Europe for the excellence of their fine, light work. The mixture is composed of fine sand, boiled linseed oil, and litharge. The sand should be very dry. To about 20 parts sand add 1 of litharge, mix them thoroughly and then sift the whole through a fine sieve. Wet with the oil to a temper of moulding sand, such as would be used for moulding. This mixture is rammed the same as one would ram all moulding sand. The board is left to dry for about 12 hours, and is then ready for use. The oil gives the sand firmness. The litharge is used as a dryer for the oil. It is not essential that all moulding sand should be used; almost any sand of fine grain will do as well. Parting sand, for instance, may sometimes be mixed with one-half moulding sand to good advantage. Should there at any time be corners or edges broken they can be mended by patching on beeswax.

In light work the keeping of the joint edges of sand mould boards sharp and unbroken, is of the utmost importance. A great many, to help preserve them, will nail all the joint edges; even then they will become ragged and cause bad joint work. The objection to plaster board for fine work is about the same. Much working in and out of the pattern soon breaks the edges. The boards made with the oil and litharge keep their edges good and true surprisingly long, and it is on account of this they are thought so well of; and any who will give them a trial will, no doubt, be greatly pleased with the results.

As an auxiliary to the fast production of small work, the match plate is often used to good advantage, the making of which, although a simple affair, is in the minds of some thought to be work requiring fine manipulations and measurements, the same as is required in the making of wooden match boards. In figures 2, 3 and 4 is illustrated the manner of constructing match plates, two patterns being selected, in one of which the indentation comes below the joint line, and in the other above it.



MAKING SMALL CASTINGS.

At No. 2 the nowel is rammed up and joint made, *F* and *E* being the patterns. The cope having been rammed up, looks as seen at top cut shown. The process so far is simply what one would do were he making a casting from each of the respective patterns. As instead of doing this we intend to construct a match plate, extended manipulations are required. As the pattern portion is moulded, what is now wanted is to mould the plate portion. This is done by building up the joint as seen at *P*, *P*, thereby giving whatever plate thickness is necessary for strength. The gates are cut the same as if the castings were to be poured by them. The cope is then closed, and the mould poured. The match plate, as seen at No. 4, illustrates its use in the moulding of castings from it. The cut shows the nowel rammed up, cope set on, and gate pin, *A*, in place ready for being rammed up. At *X*, *X*, are the cope pins. This match plate when made had projections extending out beyond the plain edges so as to fit or make grooves for the pins to fit in, and make a true joint when the mould was closed.

Should there be any overlapping of joints in the castings produced, the fault cannot be laid to the principle of making the match plate; it will be the fault of shaky or untrue pins. This point, in making the match plate as well as in using it, must be carefully watched, if true jointed castings are desired. In making wooden match boards of course different manipulations are required. The thickness of board is first made, then, by measurement, which requires care and exactness, top indentations or projections are fastened over their corresponding parts.

The match board, or plate, is only practical for such work as is, in outline, plain and without acute corners, cores or projections. In fact, of late years, since the art of making mould boards, patterns, and gates has reached such perfection, the match board or plate is seldom seen in use.

Another device which is often found very useful in the fast production of small work is the hinge. There are many different styles used. The hinge is something that might be often employed to excellent advantage in the making of difficult lifts, or in coping hanging indentations. When the center of the hinge is on a line with the center or joint of flask, the lift at the moment of starting tends towards the hinge side, thereby clearing any indentations the soonest upon side opposite hinge. To more clearly illustrate this, the cuts "inward" and "outward" are given. At inward, the center of hinge, *B*, is considerably below the joint. The moment this cope is started, the lift will be inward, as shown by the arcs, *S*, *S*. In the upper cut, on account of the center of hinge being above the joint, the reverse would be true, as shown by arcs, *R*, *R*. The distance of the hinges being so far below and above the joint, the arcs drawn from the center of hinges show a true inward or outward movement, as the cope is raised or lowered. It is evident from this illustration that the matter of having a cope go from or towards the hinge side can be controlled, thereby assisting in getting good lifts when a movement in either direction is desirable. Of course the farther from the joint center the hinge is the more rapid the outward or inward movement. The intersection of the line, *M*, *N*, with arcs cutting same, shows in what ratio the given radius or outside of flask raises compared with the inside. This ratio increases proportionately as the radius, or width of flask, increases.

The cut of flask hinges shows two styles that are handy for light work. The upper style is to be secured to the joints of flask; the lower one to the sides. Either could be constructed so as to bring the center of hinge below or above the joint, to cause inward or outward motion when first starting the cope, should it be desired.

LETTERS FROM PRACTICAL MEN.

Stealing the Trade.

Editor American Machinist:

In a recent number of the AMERICAN MACHINIST, "Foundryman" expresses very tersely some facts about the difficulties of giving apprentices a fair show to learn. But what reasoning as to the cause! The tariff! Well, that is the last count I have heard of against protection. Yet it is about as reasonable as any of the free-trade arguments.

I was an apprentice in time to have the full benefit of the low tariff of 1846. These were the good old times of "tariff for revenue only."

I was to learn the machinist's trade; but for the first year I was a general helper in foundry, blacksmith shop, and everywhere else about the works. I spoke to the superintendent about my case, and he said he did not see how he could help it. "In fact," said he, "there is no chance for a boy to learn a trade now-a-days unless he steals it." He advised me to be always on hand, and watch for chances to show by my work that I could do something.

I began the stealing process. Without any orders, I took one of a lot of 9″ sheaves, and put it in a chuck lathe and run a drill through it. The core was not set true, and I let the drill follow the hole. The foreman came along, and seeing the drill weaving back and forth, told me that sheave was spoiled, and that I would spoil every one of them if I did not hold the drill firmly in the rest. Then he showed me how. After that I could bore sheaves.

After a time I wanted to make a saw arbor. "Oh, no; you have never made an arbor. You can't do it."

I bought the material, and hired a man to turn a hand power, and made a saw arbor after working hours, sold that arbor to the firm for seven dollars, and they sold it for twelve dollars. After that I could make saw arbors.

With square thread and lighter screws it was the same way, after I had worked nights and made one that was my own. I paid for the material. It was only my trade that I stole.

I wanted to see machinery in place, that I might know what the different parts that I had seen made were to do. I could not leave the shop to go and see a mill in operation unless I took my own time for it, and I could not take a working day any more than a sailor at sea can take a day.

One noon-time a half holiday was announced on account of some public celebration. I took that afternoon to walk out a few miles, and see a flouring-mill and a saw-mill in operation. Such things paid me well, for I soon got along so that the firm could not afford to keep me as a general helper and roustabout.

I do not cast any blame upon my employers. I was treated as well as the average apprentice at that time. Business was dull, and times were harder then than they are now. Many a time I have congratulated myself on being an apprentice and sure of a job, when I have seen good journeymen unable to get work.

Such were the low tariff times.

Muncy, Pa. OLD JOUR.

Feed Motion for Drill Presses.

Editor American Machinist:

In your issue of February 23, 1884, you say, in answer to question No. 82: "Our experience is that it is very difficult to supply a proper automatic feed to a drill press. * * * If any of our readers can suggest a suitable range of automatic feeds, we shall be glad to hear from them."

If you will refer to your files, you will find that the AMERICAN MACHINIST for January 13 and June 23, 1883, contained descriptions of drill presses with feed motions which, I think, fulfill the required conditions. These machines were built by Wm. Sellers & Co., of Philadelphia, and the feed motion which you there describe as "adjusted by the well-known Sellers' feed discs," is such that it may be varied, within its limits, by any amount, large or small. It is not restricted to a set of change wheels or the different speeds of a cone pulley; but by the simple movement of a lever it is adjustable through an infinite variety of gradations, and may easily be made to suit the "size of drill" and "density of the metal." The finest feed is less than .002″, and the coarsest over .16″, and as every possible variation between these two extremes is attainable by simply shifting a lever, it appears to me that this arrangement meets all the requirements of an automatic drill press feed. FILIUS.

The Equidistant Series of Gear Cutters.

Editor American Machinist:

In your issue of February 23, Mr. Geo. B. Grant, in relation to the above subject, says, among other things, the following:

"3d. McCord's method is accurate enough practically, but is also an approximation, and not as theoretically exact and perfect as has been assumed. Its assumed method of uniformly dividing the locus curve has not been shown by him to equally divide the errors of velocity ratio, although it may do it, and *until I showed him what was wanted, was not so claimed by him.* He pays close attention to errors of form, and says not a word about velocity ratio."

If allowed to pass unchallenged, this piece of fiction might be supposed by some of your readers to be founded on fact. In order to prevent this, I will remark that I developed the theory of my method before I was aware of the existence of either Mr. Grant or his formula; have never received from him or any one else any hint or suggestion as to what was or was not wanted; and have never modified or added to my original statements in relation to it. And the "claim" which in the above quotation is represented to have been set up as an afterthought, was, implicitly if not explicitly, included in those statements; the whole theory, indeed, depending upon the truism, that the greater the error in form, the greater will be the error in velocity ratio; if one pays close attention to errors in the factor, it is needless to waste words about the products.

Again, the truth of my claim as to the degree of precision attainable is not established by my assertion, nor can it be overthrown by Mr. Grant's denials. I gave in support of it a connected chain of reasoning; now, if that reasoning is fallacious, let Mr. Grant demonstrate the fallacy. All he has thus far done in that direction is to say that he can prove one figure in one column of my table to be incorrect, which may or may not be so; the burden of proof lies upon him. But if my tables were *all* wrong, it would simply show that I am very poor at figures, and would not disprove the accuracy of the process in more competent hands. It may be safely assumed that Mr. Grant himself has at some period made a mistake in computation; but even if positively ascertained, the circumstance would not, I fancy, shake the public confidence in the rule of three.

What I have said above and previously, covers the main and, so far as I am concerned, the only question at issue; but Mr. Grant proposes some other points "for discussion," as he says.

Thus, he "objects," rather tardily, to my developing what he calls "a most clumsy invention," on the ground that it was done in order to supersede his formula. That is not at all true, and he couldn't possibly have known it if it had been; besides, every one was at liberty to select his method in preference to mine. He also "objects" to my process as being too laborious—which is less pertinent than it might be, in view of the fact that I have done all the work myself.

In the AMERICAN MACHINIST of January 5, Mr. Grant defines his formula as one by which an equidistant series can be computed "for any possible system, limits, or number of cutters;" and gives the seductive information that "it takes but a few minutes and a few figures to fit any other case" than the example he gives. Let us then make a series of 12, to cut from 26 teeth up to a rack, of which the intervals are given in the first column of the annexed table, the small tipe figures denoting the location of each cutter according to his amended rule. In computing these intervals, the value of t in the formula may be fractional, in which case presumably the nearest integer is to be used; but in this series of twelve we find six integral values, viz.: 39, 52, 78, 104, 156, 312. We note, then, that 4 cutters are required for the limits 40–78 teeth, 5 for the limits 53–312, and so on in other cases as shown:

	GRANT.						MACCORD.
1	26– 28						26– 27
2	29– 31						28– 30
3	32– 35	FOUR.	SIX.	SIX.	FIVE.	FOUR.	31– 34
4	36– 39						35– 38
	42.35	42.79					
5	40 –45	40– 46	40– 46				39– 44
	48.81	49.82					
6	46– 52	47– 53	47– 53				45– 52
	57.15	58.15	58.57	58.98			
7	53 –62	54– 63	54– 64	53– 64	53– 64		53– 63
	69.42	70.31	71.32	71.72	71.32		
8	63– 78	64– 78	65– 79	65– 80	65– 79		64– 79
	88.59		90.81	91.83	91.18	90.16	
9	79–104		80–105	81–106	80–106	79–105	80–106
	125.52		125.95	127.92	127.54	126.87	
10	105–156		106–156	107–159	107–158	106–158	107–159
	208.88			212.89	210.65	211.32	
11	157–312			160–318	159–312	159–316	160–321
12	313– ∞			319– ∞		317– ∞	322– ∞

Consequently, if the formula were absolutely precise, not only the intervals but the locations for all these different series would be identical with those in the first column, which they are not.

Mr. Grant, I know, has in advance disposed of all these discrepancies, declaring them to be "imperceptible fractions," which they may or may not be, according to the size of the cutter.

He insists that his method is good enough for him, ought to be good enough for everybody, and that if there is a better one the superiority is of "no account whatever," because, as he says, his rule gives results closer than can be worked to. That is to say: "It doesn't matter whether the bull's eye is in the center of the target or not, for you can't shoot straight enough to hit it, any way." This will not satisfy all the marksmen, even, and certainly ought not to content the man who makes the target.

There are men so unreasonable as to believe that they can work as close to the right figure as to a wrong one, and to wish for more precise information as to what the right figure is than that given by the liberty to select from even a limited and choice collection of values. And such information is to be found in the last column, which contains the intervals for a series of 12, to cut from 26 teeth to a rack, upon an epicycloidal system in which the constant describing circle is such as to give radial flanks to the wheel of 15 teeth, and the addendum is equal to the diametral pitch.

C. W. MACCORD.

Building Locomotives in Repair Shops.

Editor American Machinist:

I have noticed lately several articles in your paper, in regard to building locomotives in repair shops. Upon the careful reading of the same, one would be led to think that they were written, or paid for, by locomotive builders; for it is not probable that a master mechanic, who is capable of building, and who has built locomotives in a repair shop under his supervision, would write such articles. Every well-informed master mechanic knows that as good a locomotive engine can, and has been built in a repair shop, as in any shops where locomotive building is made a specialty; though, perhaps, where only one at a time is erected, not quite so cheaply. But the cheapest is not always the best. I believe locomotives can be built in any repair shop having the proper facilities to work with, a good master mechanic to direct, and ample work of the kind to warrant the keeping of a gang of skilled workmen, as cheaply as in any locomotive works.

There may be repair shops where good work is not done, but that is not the fault of the shop, as probably in the case written about by Mr. Ben. Hetherington, and published in your issue of February 16th. If I had been "Ben.," I should have kept still about the job "*although the valve gear is good.*" I know of locomotives running, that were built in a repair shop, at a less cost than locomotives of the same kind and dimensions built in a locomotive works, and I also know of locomotives that were built in a repair shop that excel, in every way, the majority of locomotives built at locomotive works.

CALIFORNIA.

Pumping Machinery Needing More Attention.

Editor American Machinist:

I have read with interest your editorial in the issue dated February 23, in regard to "a standard test for pumping engines," and think you have struck a very-much-neglected subject. Why is there not more written in regard to steam pumps and pumping machinery in general?

We see steam pumps on every hand in deplorable condition; pumps that should be double-acting working as though they preferred to be at one end of the stroke all the time, while the engineer persistently tinkers at the steam end, shifting valves, &c., while the pump is working worse than ever, as though to call attention to the real difficulty.

Pumps are made, through the oversight of manufacturers, with no chance to get at the valves without removing several bolts, and a bad joint to make in replacing, which requires considerable time—a serious matter in the case of boiler-feed pumps.

In regard to duty tests, I have taken part in several, and must own that I have never felt satisfied that justice had been done to all parties. I hope to hear from more practical men on this subject. HYDRAULICS.

Adrian Water Co., Adrian, Mich.

Cast Iron Locomotive Guides.

Mr. John Black, general master mechanic of the Cincinnati, Hamilton and Dayton Railroad, is using cast iron guides. He has been experimenting with this kind of guide for several years, with such satisfactory results that he is now fitting them upon all his engines. He has several locomotives which have run nearly 150,000 miles, and one cannot slip an ordinary business card between the cross-head and guide. It has been so long since they have had to line up a set of guides on account of wear, that they say they have about forgotten how it is done. Ordinary cast iron is used—not car wheel iron. Many master mechanics, who have not used cast iron guides, say when they commence to cut they go all at once. So will any journal go when it is neglected, and so will a crown sheet go down if the water is allowed to go low. With ordinary attention, cast iron guides give no trouble, and in three years none have cut or given suddenly out with Mr. Black. This seems to be another case where a material gives the very best results on one road, yet will render no service at all on roads where it is not in good repute.

Penney's Spring Cushioned Helve Hammer.

This hammer is manufactured by O. L. Packard, Milwaukee, Wis. It is intended for hard work and rough usage. The helve is hung upon hardened steel centers, and derives its motion from a wide-faced eccentric. The husk, containing the helve, is arranged to be readily lowered or raised to accommodate dies of varying thickness, thus rendering the shimming up of ordinary dies unnecessary. The length of stroke can be changed while the hammer is in motion, by means of a lever which changes the position of the fulcrum of the top beam.

The speed is regulated by means of the treadle, which controls a paper friction in a loose pulley.

The anvil block and its foundation are separate from the hammer, so that the concussion of the blow does not affect the latter.

The hammer head is long, and of cast steel; all parts, except the helve, are of steel or iron.

Personal Recollections.

By S. W. Goodyear.

MAKING SCREWS.

Leaving the heading of screw blanks, to which my last letter was devoted, brings me to a consideration of the other operations, which in their turn were necessary to transform the blank into the finished screw.

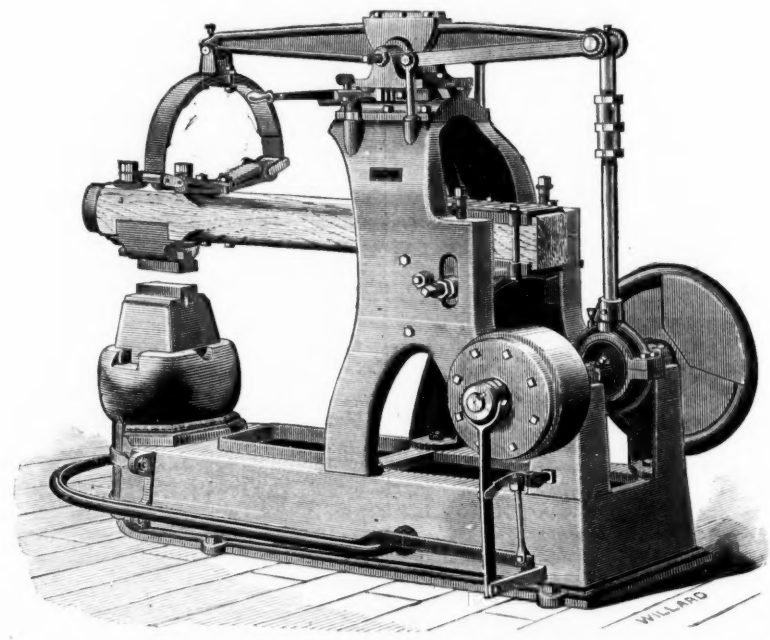
Shaving, nicking, pointing and threading were all done by automatic machines, in which the blanks were thrown in a promiscuous mass into a hopper, and, partly by gravitation, in some part conveyed by carrying disks, slides, cams and levers—each individual blank among the half peck, or thereabouts, thrown into the hopper at once, found its way to the cutter or saw, as the case might be, and under a continuous stream of soda water, which served to keep cutters cool, insure clean, smooth cutting, and protect the developing screw from rust, dropped into a box under the machine, after having received the unerring attention of the ever-ready saw, shaving, nicking, pointing or threading cutters.

CONSTRUCTING THE MACHINES.

Here were many machines to build, in which were two, three or more shafts running in boxes, the relation of these shafts to each other, and to fixed points on the bed of the machine, being of the utmost importance. Commencing by planing the seats for the boxes, planing the boxes into their places, and boring them in position with a boring bar, I soon learned that even the close workmanship and exact measurements of the best man in the shop, in setting for boring, sometimes left two shafts out of parallel with each other, or at improper distance, or the worm-shaft would not be, as it should, at right angles with the main spindle and the cam-shaft which it was to drive. A cure for this would have been to provide templates and special fixtures, to insure suitable ad justment for boring. This would, perhaps, have been better than what I adopted, but, as I hit upon a plan which proved very satisfactory and may be novel to some, I will describe it. Using the ordinary split flange boxes, such as are used in a lathe-head, I rigged up cutters and jaws to mill the boxes, instead of planing them—a departure, by the way, which met with no favor at that time with the best men, "because milling was not accurate enough," they said, but by which it was easy to mill a great many boxes just alike, with their depth just half their width, and the space between the flanges alike, and, as between the sides and top or bottom, in exactly the same plane.

MILLING THE BOXES.

As in all such work, there must be a base of operation, and there are still many shops in which the milling machine has found no place, where, if it once gets a foothold, it will soon be considered indispensable, I will describe how this milling was done. Dropping a half box between the jaws of the milling machine vise, with its superior surface against the fixed jaw, and one end uppermost, clamping it in position by using a narrow piece between the sliding jaw and the surface between the flanges, a cut was taken from the end, which would be at right angles with the broadest face. Taking this cut on the entire lot of pieces under treatment, they were next put in the same position, the other end up, and that milled off, the same as the first end had been. Now, resting the surface between the flanges on a parallel strip in the bottom of the vise, gripping the half box by the already milled surfaces between plain jaws, the superior surface was milled off. Next, turning the vise with the jaws parallel with the traverse of the cutter, with the cutter on which was to be used to mill the space between the flanges, closing the jaws upon a parallel strip and clamping the sliding jaws down at a suitable distance apart, the jaws had the cutter run between them, cutting a shoulder in each, of course perfectly parallel with the line of motion of the cutter. Then, raising the cutter, or lowering the vise to give the right distance between the face of the cutter and the bearing surface shoulders, and setting the cutter in the right position longitudinally in an axial direction, the surface between the flanges could be milled, and the inner surface of the flanges milled just right. Having been through with the lot in this direction, the vise was turned with the jaws at right angle to the traverse of the cutter, and holding the fixed jaw, which was to be used in completing the milling, between the jaws last described, a seat was cut across its inner face of sufficient depth to insure holding in place a piece of the exact width of the thickness of the cutter. Fastening this piece in place with a couple of screws, the piece being thick enough to prevent the edges of the flanges from striking the inner surface of the jaw, the jaws already in may be removed, and this one with a rib, and a plain mate put in. Now, using a straight edge against the edges of this vertical rib on the fixed jaw, the sides of the milling cutter can be brought to coincide exactly with the sides of the rib, insuring the last two cuts between the flanges coinciding exactly with the first one, making the inner surface of the flanges in the same plane all the way around an entire box.



Penney's Spring Cushioned Helve Hammer.

BORING THE BOXES.

Having in the manner described milled up a lot of boxes—sometimes five hundred pairs at a time—I next proceeded to bore them, face them up, and true up the outer surface of the flanges by putting them in a special chuck, which I had fitted to a lathe spindle for this purpose. This chuck was an exact *fac-simile* of the seat in which the box would be used in the machine. By having this chuck mounted on the live spindle of the lathe perfectly true, *i. e.*, with the opening in which the boxes were to be placed for boring, strictly concentric with the axis of the lathe spindle, the boxes were bored strictly central relative to the milled surfaces between the flanges. The sneers with which my proposition was met to mount such a chuck, sufficiently true to admit of using a box bored in it, either side or either edge up, without changing its concentricity, died away when the "how" became apparent. In my method for getting this chuck on true appears my reason for milling the boxes to such a thickness, that the top and bottom boxes together should measure exactly the same as in width. By facing off the front of the chuck and planing out the seat to an exact fit for a pair of boxes, the incomplete chuck could be attached to the face-plate of a lathe perfectly true, by turning a mandrel to an exact fit for the opening where the boxes were to be held for boring. Placing the mandrel on the lathe centers, with the chuck astride the mandrel, its planed face could be clamped to the face-plate of the lathe in a position of concentricity not to be reached by measurement. Now, the back plate of the chuck could be fitted to the lathe spindle, or it could be faced up and its periphery turned true, to be fitted into a turned sunken seat in the face-plate of the lathe. In either case, if the job was well done in a proper manner, insuring a chuck that could be depended upon to run true, to complete which it was simply necessary to put it in place on the lathe spindle, carefully face off the front, clamp it front face down on the planer, and plane the inner face down to produce a fit between the box flanges; drill and tap the cap to place, and the chuck was ready to use. Boring the boxes in this chuck and facing off their entire ends with a cutter of suitable shape fitted to a boring bar, and used as a counterbore; next, clamping them upon an arbor, by means of a strap and key—the strap exactly fitting between the flanges—insured the two halves of the box holding the right position relative to each other. The ends were finished in a hand lathe, and the boxes were made in this way by the hundred and stored ready for use, doing away with all boring-bar work on the machines. To do the planing right for the boxes, which, with a few very simple templates and fixtures, was easy to do, in this way insured having the shafts in the machine come right. The boxes were plain cast-iron; the shafts were steel. If kept oiled, these boxes lasted for years; if from lack of oil there was occasionally a box cut out, it cost but little to replace it, as we had them constantly on hand, and kept a few not bored to size to permit dressing over journals when necessary.

WORM AND GEAR MOTION.

The worm and gear which communicated motion from the main spindle to the cam-shaft, gave much trouble at first, from wearing out so rapidly, but after trying many combinations of metal, hard and soft, I found the best results with a hardened steel worm, running in a gear of Lowmoor iron, case-hardened. Why this particular combination should have been so much better than cast-iron with any other metal, than steel, running in steel hardened, or than case-hardened iron running together, perhaps some reader can tell. I simply state the fact, as I remember it, looking back twenty years or more, that a worm and gear of this kind would run almost as many months, as the other kinds would days.

THE STATIONARY HOPPER.

As, to up the time of which I am writing, it had been generally conceded that a great corporation had, through their patents on machinery and product, a monoply in this line of manufacture, it called for much care and ingenuity, to avoid trespassing upon their rights. In place of their revolving hopper, which by its motion loaded the fork-shaped carrier with blanks, to be lifted and slid into the conductor, which took them down in a row hanging by their heads, ready to be fed to the gripping jaws, we adopted a stationary hopper, through the bottom of which was an opening or mortise of greater length than the longest blank to be fed, and working up through which was a vertical slide, having a slit at its upper end in the direction of and through its entire width a little wider than the blanks were in diameter, and deeper than the blanks were in length. The top of this slide was cut to such an angle as to match the inclined conductor, in its upward extreme motion coming parallel with or slightly above the conductor, and letting such number of blanks as it had carried up and there was room for in the conductor, slide from one to the other, from their own weight. The bottom of the hopper matching the angle at the end of the slide, the inner walls sloping toward the bottom from all sides, a guard running vertically from the bottom of the hopper to the bottom of the conductor against the edge of the slide from which the blanks were delivered, and slitted through its upper end for the body of the blank to pass from the slide to the conductor—and a blank carrier were had, which worked well, and was sure and simple.

GRAVITY FEED.

To take the place of gates at the bottoms of conductors for restraining the downward motion of columns of blanks, and by an ingenious device permitting one blank at a time only to reach the place where fingers almost human in their action would take it from its hanging vertical position and deliver it to the care of other fingers, which in their turn brought it to a horizontal position and placed it in jaws to be held by the head or body, as the operation to be performed required, I determined to adopt as nearly as possible a gravitation feed, and succeeded by curving the lower end of the conductor to correspond with the curve assumed by a column of blanks one above another, in changing from a horizontal to a vertical position, owing to the body of each successive blank above the one at the bottom resting with its neck on the edge of the head of the blank next under it. With a shield over this curved portion of the conductor the blank at the bottom lay in a horizontal position, from which it was carried by an intermittently revolving disk, having at regular intervals across its periphery half circle grooves corresponding with the diameter of the blanks to be conveyed, and encircled by a shield at such a distance from the periphery, as to just let a blank resting in one of the grooves pass under it; the next blank above falling upon the edge of the plate to drop into the next groove, as it came in position, and, in turn, be carried forward under the shield. In this way, making use of the facts, that the weight of the blanks would carry them one after another to these grooves, that only one blank could get in a groove at once, and that a blank could only pass out of the conductor and under the shield when in one of the grooves, I had a feed which was very effective, simple and durable, while the carrying plate, in connection with a duplicate plate, or a reciprocating jaw, did duty in holding the blanks in position for the different operations of shaving, nicking, pointing, and threading on each of the respective machines devoted to these operations. To use a slang phrase still in vogue, "'twas just as easy as rolling off a log," when once the machines with their many cones and levers were completed.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.

JACKSON BAILEY, Vice- Pres't.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, ANGUS SINCLAIR, } Mechanical Engineers.

The American News Company,
Publishers' Agents, New York.

The International News Company,
11 BOUVERIE STREET (Fleet Street), LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage prepaid.

DEALERS SUPPLIED BY

The American News Company, New York.
The American News Company, Denver, Col.
The American News Company, Kansas City, Mo.
The American News Company, Omaha, Neb.
The American News Company, St. Paul, Minn.
The New York News Company, New York.
The National News Company, New York.
The New England News Company, Boston Mass.
The Central News Company, Philadelphia, Pa.
The Western News Company, Chicago, Ill.
The St. Louis News Company, St. Louis, Mo.
The Cincinnati News Company, Cincinnati, O.
The Detroit News Company, Detroit, Mich.
The Pittsburgh News Company, Pittsburgh, Pa.
The Baltimore News Company, Baltimore, Md.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal
The Brooklyn News Company, Brooklyn, N. Y.
The Williamsburg News Co., Brooklyn, E. D., N. Y.
The Newark News Company, Newark, N. J.
The Northern News Company, Troy, N. Y.
The Albany News Company, Albany, N. Y.
The Washington News Company, Washington, D.C
The New Orleans News Company, New Orleans, La.
The Montreal News Company, Montreal, Canada.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.

$2.50 a year, in advance, postage prepaid in the United States and Canada.
$3.50 to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
'Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen and all those especially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, MARCH 15, 1884.

CONTENTS.

	PAGE
Lidgerwood Horizontal Engine	1
Mild Steel in Boiler Construction. By George Marshall	1
The Bee-Line Policy	2
The Player Water Glass Cocks	2
Car-Builders' Club Meeting	2
Experimenting with the Hotchkiss Boiler-Cleaner	2
Exterminating the Ground-Mice	2
Workingmen's School	2
Improved Glass-Valve Wheels	2
The First American Iron-Planer	2
American Machinist for January 1 and 8, 1881, and January 7 and 21, 1882, wanted	2
How to Strike up a Propeller Wheel. By Isaac Whitehead	3
Increasing the Navy	3
The Indicator Diagram	4
A Risky Ride	4
Draft-Regulating Appliances for Locomotives. By J. Dugald Campbell	4
Apprentices in the Brooks Locomotive Works	4
Small Castings—The Mould-Board, &c. By Thos. D. West	5
Letters from Practical Men—Stealing the Trade—Feed Motion for Drill Presses—The Equidistant Series of Gear Cutters—Building Locomotives in Repair Shops—Pumping Machinery Needing More attention	5, 6
Cast-Iron Locomotive Guides	6
Penney's Spring-Cushioned Helve Hammer	7
Personal Recollections. By S. W. Goodyear	7
Shop Libraries and Reading Rooms	8
Accidents to Steamers' Machinery	8
Rewards for Improved Methods of Doing Work	8
Railroad Car Material	8
Literary Notes	9
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	10

Shop Libraries and Reading Rooms.

Many shop proprietors would do well to consider the propriety, from a purely business point of view, of establishing in connection with their works libraries and reading rooms. The argument that there is nothing in common between proprietors and workmen, except the giving and receiving of wages, is a mischievous one, and as much to the discredit of one party as to the other, and ought to be distasteful to both. It leads, logically, to the idea of getting a good deal for a little—a good deal of work for little money or a good deal of money for little work—something that never did nor will work satisfactorily. Making all due allowance for praiseworthy selfishness, or putting it entirely on the ground of selfishness, something better and more profitable than this ought to be got out of the relation between those who employ and those employed. Aside, then, from all sentiment, when a proprietor can see his way clear to furnish rooms or a room, devoted to intellectual purposes, for those who work for him, we believe it is a good business investment for him to do it. That he, perhaps, benefits others more than himself will be one of the pleasant features of the case, upon which it is not necessary to enlarge.

Men who read are better men in the shop or manufactory than those who do not, if for no other reason because reading induces habits of thinking that find their way into the products of the shop or manufactory; but there are other reasons too well known to require repetition.

Libraries supplied with the right kinds of books are not plenty, even in large cities; and in many smaller cities and towns are almost or entirely lacking. Moreover, as generally managed, they are of no use to those who ought to be benefited by them, not infrequently being closed at such hours as busy men can visit them. In other instances, those who could otherwise use them live at such distances as to be practically debarred from doing so, and in any instance there is not that sense of proprietary right that will be felt by one making use of something that is part of the works with which he is connected.

The advantages of a reading room and a well-selected library are such as many men would make some sacrifices for, and connected with a shop would be to them one of the pleasant features not to be left without strong reasons. To apprentices and young men such advantages cannot be over-rated; and, in fact, to all they are substantially the same as derived from an expenditure that few can afford.

In instances where the proprietor does not see his way clear to meeting all the expense; the propriety of co-operating with the workmen to that end is worth considering. Properly managed, a little money can be made to go a good ways in this direction, and a few books at the start will grow into a library of respectable proportions if interest in the matter is kept up. Workmen will find any little sacrifice made for this purpose is like investing money in a bank that never "breaks," and always pays a "dividend."

Accidents to Steamers' Machinery.

When an accident happens to the machinery of a steamer in mid ocean of such magnitude as to disable the operating of the propeller, it places the vessel in the most precarious condition. Although all ocean-going steamships are provided with sails, which are supposed to provide means of controlling a vessel after the propeller has been rendered useless, the recent cases of the Celtic and the Germania indicate that the canvas carried is not sufficient to prevent such vessels from drifting helplessly away from their course when severe weather is encountered. The sentiment has been widely spread around that steamship companies are best able to judge as to the precautions necessary for securing the safety of their ships and the comfort of the passengers; but accidents to high class steamers have been so frequent of late that we are disposed to question the truth of the assertion that the breakages were unavoidable and beyond human foresight. The tendency of all great corporations is to be conservative, and the let-well-enough-alone policy seems to have prevented the adoption of appliances that would lessen the shocks to which marine machinery is often subjected. The massive forgings needed to transmit the tremendous aggregate of power employed in propelling high-speed steamers, must be produced of the very best material, and worked with the highest degree of skill, or weak spots will be left which, sooner or later, will lead to disaster. The breaking of the main rod of the Aurania, which led to such a serious smash; the flaw discovered in the piston of the Oregon, which disabled a cylinder on the first trip of the vessel, and the breaking of the Celtic and Germania crank shafts, would seem to indicate that something less than first-class material or workmanship were employed upon very pretentious vessels. It would be interesting for the traveling public to know how far the shafts which broke were influenced by the cause that brought the Aurania to grief, viz: defective workmanship.

Owners of steamships do not take proper precautions to prevent the machinery from getting strained during bad weather. When a steamer is working through a heavy seaway the racing of the machinery caused by the propeller being raised out of the water, throws a terrible shock upon the working parts when the screw dips quickly back into the sea. To this cause is, no doubt, due many incipient fractures which end in a disabling break. Steamer owners have acted as if the control of the engine in heavy seas is a problem beyond the reach of mechanical science. There is no prospect of immediate great gain from the use of mechanism that would hold the engine speed practically uniform, so there is no demand for an invention of the kind, and racing is checked in the most bungling fashion by a man standing at the throttle during bad weather, the same as was customary when the steamboat was first brought into use. If steamer owners were as much interested in controlling the speed of their engines as manufacturers are, there would be no cause to complain of the dangers resulting from marine engines racing. In some manufacturing establishments, serious damage would ensue to the machinery were the engine to increase its speed more than a revolution or two a minute, the result being that governing mechanism has been perfected till the load may instantly be varied from 20 to 200 H.P. without material change of speed. An approximation of this control of engine speed could be obtained with marine engines, if the owners were anxious to secure it.

The plan adopted by several large English engineering firms of giving rewards to men who improve on their methods of doing work, either by the introduction of new simple tools, or by applying present tools to new purposes; or, in fact, who through anything relating to the tools used or the product of the shop, introduce ideas of value, is a far-sighted plan of availing themselves of the use of the brains of their workmen. It partakes of the nature of co-operation between employer and employe; something which almost universally results in mutual benefit. Anything that will induce men to think is a good thing, and nothing is likely to do this—no matter who the men or man—but the prospect of reward for thinking to some purpose. It may be urged that men who invent and plan, in the shop as elsewhere, are always in the way of promotion, but this lacks the definiteness that the certainty of immediate payment for such work carries with it. All workmen cannot, in the nature of things, be foremen or superintendents, but these are not the only ones worthy of pay for work other than that done with the hands. One of the unfortunate things about present shop systems is, that there is too little about them that cultivates habits of thought. Anything that will do this is important. While crying out for the need of higher mechanical education, it is not wise nor profitable to overlook means already at hand. So far as tried, we believe this plan of English firms has been entirely satisfactory, and it certainly seems worthy of almost universal adoption.

To satisfy a large number of inquiries for copies of the fifth catalogue of the American Society of Mechanical Engineers, noticed in our columns recently, we wish to say that application made to F. R. Hutton, secretary, 15 Cortlandt Street, New York, will doubtless procure a copy of the pamphlet, together with all necessary information regarding method of becoming connected with the society.

Railroad Car Material.

From the expressions of opinions heard at the various master car builders' meetings on the desirability of having all cars made according to standard dimensions, it can be seen that railroad men generally are strongly in favor of establishing an exact standard for cars. The principal obstacle to the adoption of a standard car is that each master car builder thinks that his car should be taken as the basis on which to build the standard, and as the car patterns are extremely different on the various roads, the parties interested will not agree that a rival's car is better than their own. There has been great progress in the sentiment in favor of standard parts among railroad men during the last ten years, and leading railroad mechanics are seldom met in these days who do not believe in interchangeability in car and locomotive construction. If others would agree to take his car as the standard, there are few master car builders who would not advocate that axles, oil boxes, brake shoes, and other truck parts should be made to exact standards, and they are also ready to extend the system to timbers and every other part of the car body. So it may be concluded that master car builders are willing to adopt a standard car, with every part from roof to rail interchangeable, if they could only agree upon the most suitable form and dimensions.

There is not much likelihood of the master car builders coming to an agreement very soon, and we are heterodox enough to believe that it is fortunate for railroad interests that they do not decide upon a standard car at present. The railroad interests of America are not yet prepared to say what shall be the standard car of the future, either in regard to size or material. The existing tendency is towards a heavier car than is now in use, and although master car builders hold with unanimity to wood as a building material, the inevitable march of improvement will eventually compel them to introduce iron or steel largely into car construction.

The successful and economical operation of railroads having been so much influenced by the improvements in the manufacture of iron and steel, it might naturally be supposed that railroads would take the lead in adopting those materials whenever they could be used judiciously in construction, and in most respects they have done so. Yet amidst all this, the curious anomaly is presented of the master car builders, who control an important branch of construction connected with railroad equipment, keeping rigidly aloof from iron and steel so far as circumstances will permit them to do so. The fondness of master car builders for wood as a building material resembles that of the British lords of the Admiralty for England's wooden walls after wood had become obsolete as a ship building material. Had the master car builders kept in line with the progress of other railroad departments, the whole car trucks would now be made of iron or steel, and the sills, or even the whole skeleton of the car body, would be metallic. There has been too much inclination to regard any departure from established usage as a step away from the safe path. Iron tender frames are a most decided improvement over those of wood, and are becoming deservedly popular; but their use was deprecated for years by parties who thought wood alone was suitable for that purpose. The success with the iron tender frame ought to encourage some enterprising car builder to try a similar experiment

with car frames. Advances of that kind could be made by degrees, and experience would demonstrate the strong and the weak points of the new building material. This would be a much better way of bringing it into use gradually, than by building a car entirely of iron or steel and saying, "If this does not prove so satisfactory as a wood-built car it is a failure, and we will stick to the timber." By introducing metal gradually as a material for car building, the present appliances for building and repairing wooden cars could be used until they were worn out, and the proper machinery for working metals could be provided as it was needed. During the transition of shipbuilding from wood to iron, many composite vessels were built partly of iron and partly of wood as a compromise between the old and the new material, and they helped to bridge the chasm. A similar plan might work advantageously in leading the more conservative master car builders into the way of familiarizing their minds with metal cars, for a change to that direction must be made sooner or later.

The general master mechanic of a prominent railroad contends, under the name of "California," in another column, that locomotives can be built as well, and more cheaply, in repair shops than they can be made by regular builders. Our correspondent is in a position to know whereof he speaks, from wide personal experience in that kind of work, and his opinion is entitled to the highest consideration. But he is mistaken in supposing that our previous letters taking the opposite view were "written or paid for by locomotive builders." We believe all the correspondence on the subject has expressed the honest convictions of the different writers. The production of first-class locomotive work at very low cost, through excellent methods and management, is not confined to contract or to repair shops, and the friends of either side may claim the advantage without any question of their sincerity.

If any of our readers have clean copies of the AMERICAN MACHINIST bearing date January 1 and 8, 1881, or January 7 and 21, 1882, which they are willing to dispose of, we shall be glad to buy them back at 50 cents each. Must be in good condition for binding. The sender should pencil his name on the wrapper, and send us a postal card advising us that papers have been mailed. We will remit promptly on receipt.

Literary Notes.

The *Cornell University Register* for 1883-4 is before us. It contains the usual information as to the courses of study in each department, and the catalogue of students. There are 439 students in the institution, of which 176 are in the Freshmen class, and 66 Seniors. The students in the Department of Mechanic Arts are distributed as follows: Seniors, 4; Juniors, 3; Sophomores, 7; Freshmen, 19; Special, 2.

We are in receipt of the nineteenth annual catalogue of the Massachusetts Institute of Technology, of Boston. It gives full information about the facilities of the institute and the different courses of study. There are now 443 students. The regular course in the School of Mechanic Arts covers two years, but those who, for want of time or means, are unable to take the full course will be received for shorter times or for particular parts of the course. Applicants for admission must be at least 15 years old, and pass an examination in arithmetic, geography and English composition. For shop-work only, or mechanical drawing, no examination is required. Tuition fee for regular course is $150 a year; special courses charged less. No extra charge is made for materials or for the proper use of tools, except where students pursue two or more branches of shop-work at the same time. The course embraces 1. Carpentry and Joinery; 2. Wood-turning; 3. Pattern-making; 4. Foundry work; 5. Iron forging; 6. Vise-work; 7. Machine tool-work. There are 56 students in the School of Mechanic Arts.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(107) P. Q. B., Wurtersville, N. Y., asks: How can I clean brass? *A.*—See answer to question 313, AMERICAN MACHINIST of September 29, 1883.

(108) J. A. S., Effingham, Ill., asks: How can I blue a gun barrel that is nicely polished? *A.*—Apply nitric acid, and after it has eaten the barrel slightly, clean with oil and burnish.

(109) J. R. G., Pawtucket, R. I., asks: Give me a rule for the expansion of different metals by heat? *A.*—Authorities differ on this subject, and we know of no one who is competent to decide. More investigation is needed. You can find rules in any engineer's pocket-book.

(110) J. B., Indianapolis, Ind., writes: I am running an engine, 14"x20, at 100 revolutions per minute. The fly-wheel is 12 feet diameter, and is about 96 lbs. heavier on one side than on the other. Will the engine run worse or better for this? *A.*—We should say it would not run so well. We should balance the wheel.

(111) W. U., Worcester, Pa., asks: 1. Why do you not approve of returning the heat back over the top of a boiler? *A.*—Under some circumstances the heat may be more intense than sheets without water against them should be exposed to, especially when no steam is being withdrawn from the boiler and the steam possibly superheated. In other instances the gases may be of a temperature lower than the steam, robbing it of heat and making it "wet."

(112) O. M., Brooklyn, N. Y., writes: It has occurred to me, in reading "Running a Lathe," in a recent issue of the AMERICAN MACHINIST, that it would be better not to cut the thread on the spindle up to the shoulder, but to leave about ⅛" blank, and bore out the chuck for the same distance. Would it not in this way be easier to mount the chuck on the spindle? *A.*—It is the custom to leave a small blank space and bore out the hub to fit this blank part. See article "On a Standard System of Parts for Machine Tools," in our issue of March 1.

(113) F. C., Flemington, N. J., asks: How can I demonstrate that in two circles of different radii, angles at the centers subtended by arcs of equal length are to each other inversely as the radii? *A.*—It follows from the fact that the circumferences of the two circles will vary directly as their radii. For instance, take two circles, one of one inch and the other of two inches radius. The angle drawn to one-sixth the circumference of the smaller circle will be an angle of 360÷6=60°, and the one drawn to the same length of arc of the larger circle will be 360÷12=30°.

(114) G. E. H., San Francisco, Cal., writes: I wish to harden the heads of hexagon cap screws in a case-hardening furnace. Do you know of any way of conveniently doing so without hardening the body of the screw? *A.*—You can cover the body of the screw with a tube larger than the body, and fill in around the body with fire clay. This will prevent the body from hardening. A better way is to harden the entire screw, then heat so as to draw the temper, or anneal. This will leave the outside surface in the condition of soft steel. You can then heat and harden the head precisely as if it were a steel screw.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gears—G. B. Grant, 3 Alden st., Boston; water motors

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Special Machinery—C. D. Lambert, New Haven, Ct.

James W. See, Consulting Engineer, Hamilton, O.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

F. VanWinkle, Mech. Engin'r, 22 Cortlandt St., N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

Spanish translations of catalogues, circulars, &c. J. M. Da Rosa, 260 East 3d St., Cincinnati, O.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Consulting Engineer and Mechanical expert, C. C. Hill, 84 Market street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

Machine tools and supplies, steam engines, gas engines, ⅛ to 1 H.P. Send for large illustrated catalogue. Jackson & Tyler, Baltimore, Md.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

H. O. Reinhardt, M. E., Mem. Am. Soc. Mining Eng., Chihuahua, Mex., invites correspondence of man'f'rs of machinery desiring to introduce same in Mexico.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Catechism of the Locomotive."

The most complete and easily understood treatise on the locomotive; 625 pages, 250 illustrations. $2.50. For sale by "The Railroad Gazette," 73 Broadway, New York.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Any of our readers who have complete files of Volumes I. and II. in good condition, bound or unbound, can probably find a purchaser by addressing us, and stating the lowest price they will accept. AMERICAN MACHINIST PUBLISHING COMPANY, 96 Fulton street, New York.

BOUND VOLUMES of the AMERICAN MACHINIST for 1880, 1881, 1882, and 1883, for sale at $3 50 per volume express charges to be paid by purchaser. We will pay 50 cents per copy, to any of our readers who will forward us the first two numbers of 1881, or Nos. 1 and 3 of 1882. They must be clean and in good order. AMERICAN MACHINIST Pub. Co., 96 Fulton Street, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N. Y.

Patent "Common Sense" Binder for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address, in the United States, by mail for one dollar. To Canada and foreign countries 75c., the purchaser to pay custom-house duties and express charges. American Machinist Publishing Co., 96 Fulton street, New York.

MANUFACTURES.

The Texas Pacific Railroad is building a round-house at Bonham, Texas.

It is rumored that Rorer & Chapman will erect a new iron furnace at Roanoke, Va.

W. H. Brooks and others, of Alexandria, Va., will start a chain and bolt factory.

Liddell & Co., Charlotte, N. C., have started to build a new foundry and machine shop.

A woolen mill to cost $30,000 is soon to be erected at Riverside Springs, near Colorado, Texas.

The King Drill Company, of Logansport, Ind., is a new corporation. The capital stock is $36,000.

P. C. Holmes & Co., Gardiner, Me., will build a brick addition to their machine shop in the spring.

The Colorado (Texas) Oil Company has been incorporated with $50,000 to build a cotton-seed oil mill.

It is reported that Youngstown, O., capitalists have selected a site in Cleveland for extensive car works.

The Hagan Steel Car-Wheel Company, with a capital of $100,000, has recently been organized at Three Rivers, Mich.

A joint-stock company has been organized in Durham, N. C., for the purpose of manufacturing woolen goods.

W. K. Burton, of Elyria, Ohio, will probably start a factory for ornamental wrought-iron work in Chattanooga, Tenn.

Reed Brothers, the tack manufacturers, are to erect at Brockton, Mass., a factory 125x40. Work will be commenced soon.

A stock company, for the establishment of a cotton mill, has been organized in Shreveport, La., with a stock capital of $150,000.

J. C. McCaskill, of Shoe Heel, N. C., will establish a cotton factory at Fayetteville, N. C. So says the *Baltimore Manufacturers' Record*.

The *San Antonio* (Tex.) *News* says that town needs cotton and woolen mills, a cotton compress, an oil mill, and various other factories.

The Lexington Manufacturing Company, Lexington, Va., will complete foundry in spring; also talking of starting woolen factory.

The city council of La Grange, Texas, has passed an ordinance exempting from city taxation all capital invested in manufacturing enterprises.

The Cleveland, O., Safe Company, lately organized, will occupy the foundry property formerly used by the Cleveland Bridge and Car Works.

The Muskegon (Mich.) Car Works will be enlarged by an addition, 80x130 feet, to be occupied by the wood-working department.

Hayes, Howland & Cook, at Fall River, Mass., have incorporated a stock company with a capital of $160,000, for the manufacture of their patent belt protector.

The Stiles & Parker Press Company, of Middletown, Conn., are running until 8 o'clock at night to fill orders. They have recently brought out several new machines.

It is reported that Cleveland, O., has in contemplation the erection of a cotton mill that will give employment to one thousand persons. The company will have a capital of $500,000.

The new round-house of the Baltimore and Ohio Railroad, at Mt. Clare, near Baltimore, has been completed. It is 770 feet in circumference, and is a veritable Jumbo among round-houses.

The St. Louis *Age of Steel* says the Helmbacher Forge and Rolling Mill Company, of that city, have purchased an old factory building with a view to enlarging it and converting it into a machine shop.

The new woolen mill at Gridley, Cal., will start with a capital of $80,000, one-eighth of which is contributed by five experienced operatives in Massachusetts. The Massachusetts parties are to run the mills.

A new rolling mill, the first one in the State, has just been started up at Houston, Texas, and it will engage in making light T rails. If the business proves a success, the works will be speedily enlarged.

A new price-list and circular of can-makers' tools has been issued by the Ferracute Machine Company, Bridgeton, N. J. Everything required in can making (except the sheet metal stock) is plainly set forth.

The new cotton mill at Durham, N. C., will cost $150,000 or $200,000, and it is expected that the mill will be in full operation before the end of the year. It is also understood that J. A. Odell, or Odell & Co. of Greensboro, is to manage the business.

Macon, Ga., wants a plow factory; Jackson, Ga., a cotton factory; Fort Worth, Tex., a woolen factory; and Lake de Funiak, Fla., both a woolen and a cotton mill. C. C. Banfill, of the last-named place, offers some inducements to manufacturers to locate there.

The new cotton factory at Rome, Ga., which has been running about eighteen months, has been kept busy of late, day and night, and the business has justified the managers in doubling the capacity of the mill. They evidently are not afraid of "overproduction."

W. H. Warren, Worcester, Mass., is well supplied with orders for radial drills. He has lately sold one to Goss Marine Iron Works, Bath, Me.: one to San Jose, Cal.; one to Brown & Sharpe Manufacturing Company, Providence, R. I.; and one to Winchester Repeating Arms Company.

The *Brenham* (Tex.) *Banner* says the city council of San Antonio has passed a resolution exempting factories from taxation for ten years. "Several Texas cities have already passed similar ordinances, and if Brenham can get any factories, she might profitably do the same thing."

Cooke & Co., 6 Cortlandt street, New York, have taken the agency of Royce & Pulling's steam pumps, which are manufactured at Columbus, O. They have an illustrated descriptive catalogue of these pumps, giving sectional as well as exterior views, which they will supply upon application.

Uniontown, Pa., wants a rolling mill, and undismayed by the essays on overproduction in daily newspapers, several Pittsburgh men have offered $20,000 if the citizens will raise $30,000 towards building the mill. At a recent meeting, the Uniontowners got subscriptions for $15,000, and it looks as if the mill is to be built.

The 1884 annual catalogue of A. Harris, Son & Co (limited), Brantford, Ont., describes (with cuts) the different mowing, reaping, and binding machines made by that establishment. These machines are well known and extensively used in the Dominion, and their popularity seems to be increasing. Hosts of purchasers are mentioned by name and address in the catalogue.

The new Seaconnet corporation, at Fall River, Mass., has elected H. C. Lincoln, president, Milton Reed, clerk, J. E. Cunneen, agent, and Edward A. Chase, treasurer. Capital is $400,000. A mill is to be erected to run about 34,000 spindles. It will be of stone, four-stories high. The boilers, over 1,000-horse power, have been ordered of Kendall & Roberts, Cambridgeport, Mass.

Williams & Diamond, of Flushing, N. Y., have bought land adjoining the Worthington Hydraulic Works, in Brooklyn, N. Y., and are completing plans for the erection of a large shop for their drop forging works. All the modern appliances are to be furnished for that line of business. We understand power will be furnished by a 75-horse power Straight-Line engine.

Thirty-five acres of ground, extending from Halstead street east to Wallace, south of 55th-street boulevard, has been purchased, together with five acres on the northwest corner of Halstead and 57th streets, by the Suspension Car-Truck Manufacturing Company, who will at once, it is stated, proceed to erect factories. Over $100,000 will be expended within a few months, and the entire construction will be in brick, stone, and iron, with slate roofs. It is expected to have the works completed and occupied by September 1.—*Chicago Industrial World.*

Machinists' Supplies and Iron.

NEW YORK, February 28, 1884.

There has been very little change in the condition of the supply business since last week.

In Iron a steady tone prevails, and with few exceptions supplies are held on the basis of our previous quotations. Both for pig and manufactured iron the demand is tame, although there is more business doing than there was in the beginning of the year. No. 1 X Foundry is quoted at $20.50 to $21.50; No. 2 X Foundry, $19.50 to $20; Grey Forge, $16.50 to $17.50, in moderate demand.

Scotch pig—A moderate amount of business has been done in this line during the last four days. Coltness, $21.50 to arrive, and $22 to $22.50 from yard; Glengarnock, $21 to arrive, $22.50 yard; Gartsherrie, $23; Summerlee, $21.50, to arrive, $22 yard; Carnbroe, $20.50; Eglinton, $20; Langloan, $21.25 to arrive; Dalmellington, $20.75 to arrive.

Antimony—Regulus has been in moderate demand, with supplies firmly held at previous prices. Hallett's, 11¼c.; Cookson's, 11¾c.

Copper—The demand for ingot is moderate, and the market presents a very quiet appearance. Lake, 14⅜c. to 15c., other brands 14c. to 14½c.

Lead—Since last week large sales of common pig have been made for 4c. Sellers are now unwilling to accept less than 4.05 to 4.10c. The market may be called firm.

Tin—The market has ruled quiet and steady. Banca, 19¾c.; Straits and Malacca, 18⅛c. to 18¼c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Mechanical draughtsman wants situation. Specialty, machinists' tools. Excellent references. R., Box 10, AM. MACHINIST.

Responsible position wanted, by experienced mechanical engineer and draughtsman. Address Steam Engine, AM. MACHINIST.

First-class, experienced mechanical draughtsman desires situation. Address E. L. H., 215 Ohio street, Chicago, Ill.

Wanted—A situation as mechanical engineer. Have had much experience in erecting new works: can make drawings and superintend pattern making. First-class references. M. E., Box 7, AM. MACH.

Wanted—An experienced and capable married machinist; would like to make liberal engagement with some enterprising manufactory in a thriving country town. Address Tools, Box 13, AM. MACHINIST.

Wanted—Situation, by a thorough machinist, who is also experienced in design, drawing and construction of general machinery; competent to estimate costs and manage men. "Good parties can make liberal terms." Address "Helias," AM. MACHINIST.

A mechanical engineer, having fifteen years' business experience, desires to obtain a position with some machinery or manufacturing establishment, with opportunity to invest means in the business, after trial and investigation. Undoubted references. Address C. J., Box 14, AM. MACHINIST.

Wanted—A man capable of superintending construction of portable and stationary engines, boilers, and saw mills, and managing 200 employes. Middle-aged man preferred, and must be thoroughly competent and of sober habits. Location in Pennsylvania; position permanent, and pay liberal. Address Builder, Box 9, AM. MACHINIST.

Iron Hand Screws—4 in. 50c., 5 in. 75c., 6 in. $1. Strong and neat. E. R. Brown & Son, Windsor, Conn.

Small Boat Engine Castings—Send stamp for circular. J. L. Lucas, Waterbury, Conn.

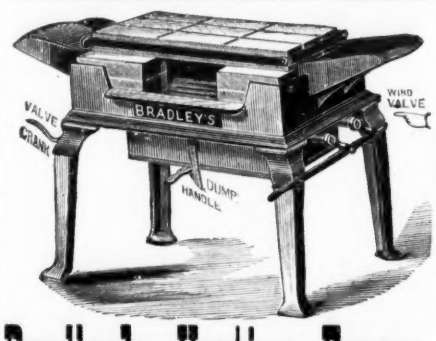
To Engine Builders—State right for sale—New patent slide-valve cut-off governor acts direct on slide valve. Small sum down, part profit until paid. Address to G. H., AM. MACHINIST.

MACHINISTS' TOOLS
FOR
IRON AND BRASS WORK,
Fox, Turret and Speed Lathes,
GEORGE GAGE, Waterford, N.Y.

PATENTS.
H. N. LOW,
Attorney and Counsellor at Law,
SOLICITOR OF PATENTS,
Office, 501 F STREET, WASHINGTON, D. C.
Patents Procured in the United States or Foreign Countries. Personal Attention to all practice before the Patent Office or Courts.
Pamphlet of Information sent free upon application

FAY & SCOTT,
Dexter, Me.,
MANUFACTURERS OF WOOD LATHES,
Drill Lathes, Shaping Machines,
Milling Machines, Planer Centers, &c.
SEND FOR CATALOGUE.

HILL, CLARKE & CO.
36 OLIVER STREET,
Boston, Mass.
BRANCH OFFICE, 800 N. 2nd STREET,
St. Louis Mo.
Have just issued new
CATALOGUE
—OF—
LIGHT MACHINERY & SMALL TOOLS.
Sent free to Manufacturers and Dealers on receipt of their business card.



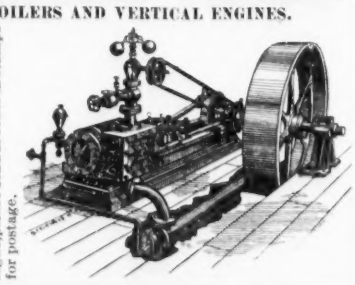
Bradley's Heating Forges,
FOR HARD COAL OR COKE,
BRADLEY & CO., - Syracuse, N. Y.

FOR SALE, ONE 9 FOOT BORING AND TURNING MILL, with two heads, built by Niles Works, Cincinnati, Ohio. In very good working condition. *Will be sold at a low figure.* We have contracted with the Niles Tool Works for a mill to swing 20 feet, and therefore offer the small tool for want of room. Address,
COLUMBUS MACHINE CO.,
COLUMBUS, OHIO.

FOR SALE.—The Patent and established business of a well-known Brass Specialty. The business is well established and trade is increasing. Will sell the Lathes, Special Tools, Patterns, Patent and the good will of the business, together with what stock there is on hand both finished and in process of completion. Satisfactory reasons given for disposing of the business. A rare chance for an investment that will pay a good profit. The business can be moved to any part of the United States at the pleasure of the purchaser. Address, Brass Works, care AMERICAN MACHINIST, 96 Fulton Street, N. Y.

STANDARD STEEL CASTING CO.
Thurlow, Penn.
STEEL CASTINGS
TO ANY PATTERN OR WEIGHT.
Strength and Quality Equal to Steel Forgings.

COOKE & CO., DEALERS IN
MACHINERY & SUPPLIES,
No. 22 Cortlandt Street, New York.
HORIZONTAL ENGINES,
BOILERS AND VERTICAL ENGINES.



In writing for circular, please mention this paper, and state what articles you want circulars of. If you want complete machinery catalogue, please send 20 cents in stamps for postage.

JUST PUBLISHED!
New and Complete Illustrated Catalogue,
OF BLAKE'S — IMPROVED — STEAM
PUMPING MACHINERY.
SEND FOR A COPY.
Address, GEO. F. BLAKE MANUFACTURING COMPANY,
95 & 97 LIBERTY STREET, NEW YORK. | 44 WASHINGTON STREET, BOSTON.

The Deane Steam Pump Co.,
HOLYOKE, MASS.
92 & 94 Liberty St. NEW YORK. | 54 Oliver St. BOSTON | 49 N. 7th St. PHILA. | 226 & 228 Lake St. CHICAGO. | 620 & 622 N. Main St. ST. LOUIS.
MANUFACTURE
STEAM PUMPING MACHINERY
FOR EVERY POSSIBLE DUTY.
Independent Condensing Apparatus
A SPECIALTY.

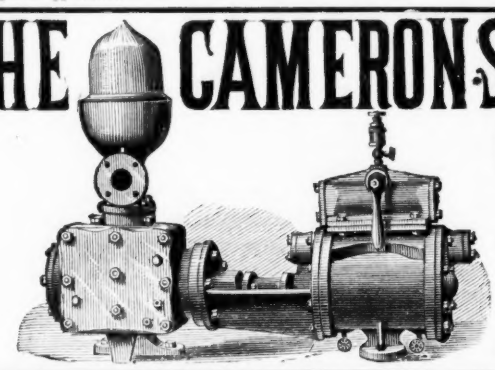
Send for New Illustrated Catalogue.

UNION STONE COMPANY, Boston, Mass
Emery, Quartz, Corundum, Wooden Polishing Wheels, Automatic Knife Grinding Machines.
Catalogue on application.

The Diamond Tool, for Dressing or Trueing Emery Wheels.

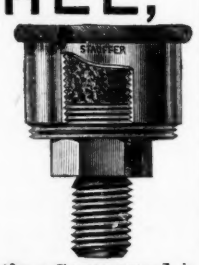
Manufacturers of the
Union Emery Wheel
Emery Wheel Machinery & Tools a Specialty.
Grinders' and Polishers' Supplies.

THE CAMERON STEAM PUMP



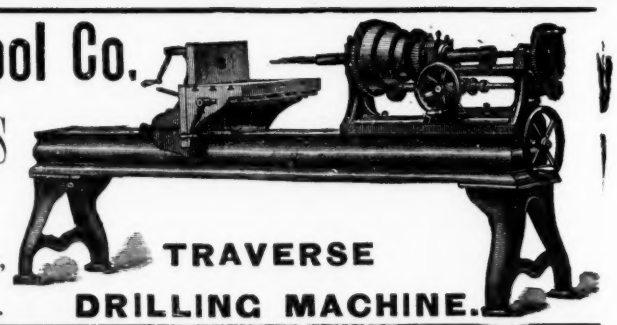
Is the Standard of Excellence
AT HOME AND ABROAD.
THE A. S. CAMERON
Steam Pump Works,
Foot of East 23d St., New York.

A. EDW. BARTHEL,
ENGINEER,
111 LIBERTY STREET, NEW YORK. P. O. BOX 2837.
SOLE MANUFACTURER OF THE
REISERT, STAUFFER AND BARTHEL
Lubricators and Solidified Oil.



The most economical, perfect, practical, simplest, cheapest, and elegantly finished Lubricators ever put on the market. One million sold within a couple of years. The **Barthel Solidified Oil or Lubricating Compound** is used with the **Lubricators** exclusively. Whoever has once tried this Lubricant will never again use oil or any other Lubricating compounds. Send for Illustrated Catalogue.

The Star Tool Co.
Machinists' Tools



Factory: Providence, R. I
Offices:
BOSTON, MASS., 220 FRANKLIN STREET,
CHICAGO, ILL., 228 LAKE STREET.
TRAVERSE
DRILLING MACHINE.

NOTES IN
MECHANICAL ENGINEERING.
Compiled principally for Students, but also of great value to all Mechanical Engineers. By HENRY ADAMS. 93 pages, 12mo, $1. Descriptive Catalogue (100 pages) free
E. & F. N. SPON, 35 Murray St., N. Y.

B. BURBANK & CO.,
MINERS AND SHIPPERS OF
FLUOR SPAR,
Furnished in any quantity. EVANSVILLE, IND.

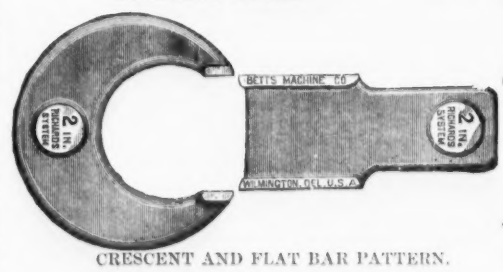
THE ALLIGATOR WRENCH,
Teeth cut diagonally, Grips Round Iron or Pipe.
PATENTED AUGUST 31, 1875.

Falcon Wrench.

AMERICAN SAW CO., Trenton, N. J.

STANDARD GUAGE.

BETTS MACHINE CO.
Wilmington, Del.,
MAKERS OF
Measuring Implements.
STANDARD GAUGES,
ANY Size from ¼ inch to 6 inch.
GUARANTEED ACCURATE
TO 1-10,000th OF AN INCH.



CRESCENT AND FLAT BAR PATTERN.

Over 25,000 of these Gauges in use.
MEASURING MACHINES,
THREE SIZES.
4 Inch, 12 Inch, and 24 Inch,
Will measure to the 1-10 000th of an Inch.

NICHOLSON FILE CO.,

SOLE MANUFACTURERS OF

FILES AND RASPS

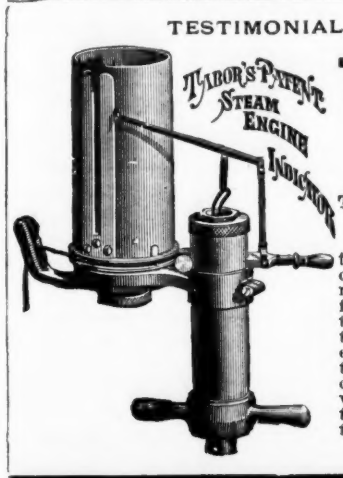
HAVING THE INCREMENT CUT.

Also, FILERS' TOOLS AND SPECIALTIES

"Nicholson File Co's" Files and Rasps, "Double Ender" Saw Files, "Slim" Saw Files, "Racer" Horse Rasps, Handled Rifflers, Machinists' Scrapers, File Brushes, File Cards, Surface File Holders, Vise File Holders, Stub Files and Holders, Improved Butchers' Steels.

Manufactory and Offices at PROVIDENCE, R. I., U. S. A.

TESTIMONIAL ON THE MERITS OF THE



TABOR INDICATOR.

ARMINGTON & SIMS ENGINE CO.,
PROVIDENCE, R. I., Dec. 28th, 1883.

THE ASHCROFT MFG. CO.,
111 Liberty Street, New York.

Gentlemen:—Your letter received. Our experience with the Tabor Indicator has been satisfactory. We ordered one of your first Indicators to test our 12x12 engine, running 350 revolutions per minute. This was the first engine we built for Mr. Edison, and was sent to the Paris Electrical Exhibition with his large dynamo. We used every Indicator attainable at that time, but all save yours failed to do the engine full justice. To the exact and excellent testing of the Tabor, therefore, is our commercial success in a measure due. We have built 135 engines for Mr. Edison, nearly all of which have been tested by your Indicator. We now have three Tabor Indicators, and you have our order for one pair to be sent to England.—Yours truly.

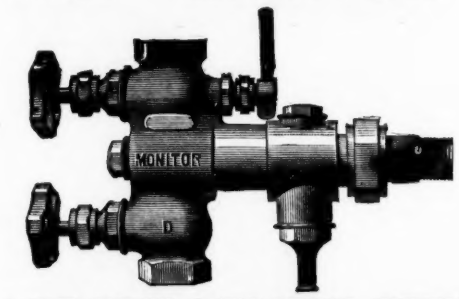
GARDINER C. SIMS, SUPT.

MILLING MACHINES.

Universal, Manufacturing and Special.

C. E. LIPE, SYRACUSE, N.Y.

THE "MONITOR."



A NEW LIFTING & NON-LIFTING INJECTOR.

BEST BOILER FEEDERS IN THE WORLD.

FRIEDMANN'S

Patent Ejectors,

OR

WATER ELEVATORS,

For Conveying Water and Liquids.

Pat. Oilers, Lubricators, &c.,

NATHAN MFG. CO.

Patentees & Manufacturers,

92 and 94 Liberty Street, NEW YORK.

Send for Illustrated Catalogue.

PATENT HOT POLISHED SHAFTING.

Superior to any shafting in market for the following reasons, viz.:

1st.—It is perfectly straight and round.

2d.—It can be rolled accurately to any desired gauge.

3d.—It has the beautiful blue finish of Russia Sheet Iron, rendering it less liable to rust or tarnish than shafting of the ordinary finish.

4th.—It will NOT SPRING or WARP IN KEY SEATING like most of the other manufactured shafting sold in the market, and as a consequence, is admirably adapted for LINE AND COUNTER SHAFTING.

5th.—The surface is composed of MAGNETIC OXIDE OF IRON, forming a superior journal or bearing surface.

6th.—It is made of superior stock.

Sizes made from ⅞ to 3½ inches, advancing by sixteenths.

Price lists, with references and other information furnished on application to

AKRON IRON CO.,

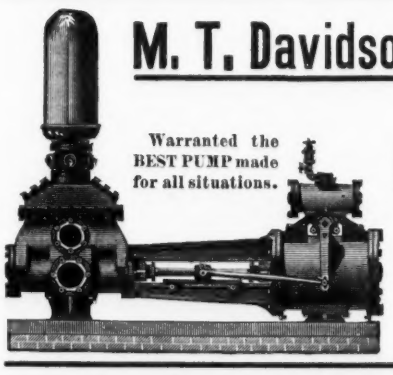
AKRON, O.

Sole Manufacturers,

Or **E. P. BULLARD, 14 Dey St., New York,** General Eastern Agent.

THE

M. T. Davidson Improved Steam Pump,



Warranted the BEST PUMP made for all situations.

MANUFACTURED BY

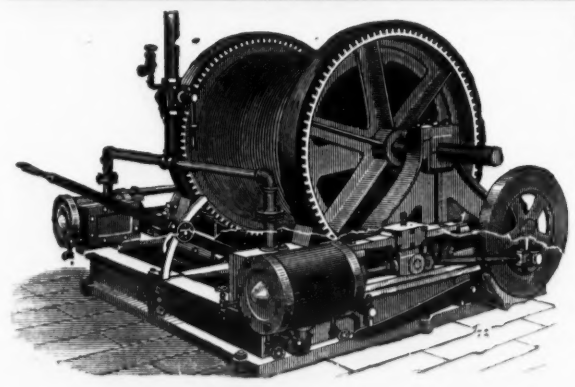
DAVIDSON STEAM PUMP CO.

OFFICE AND WORKS:

41 to 47 Keap Street, Brooklyn, N. Y.

Philadelphia Agent:

DANIEL KELLY, 51 North Seventh Street.



Improved Hoisting Engines

Specially adapted for

MINING PURPOSES.

ALL SIZES.

With Reversible Link Motion, or Patent Friction Drum.

Manufactured by the

LIDGERWOOD MF'G CO.

Offices and Salesroom: 96 Liberty Street, N. Y.

Works: Partition, Ferris, and Dikeman Streets, Brooklyn

G. S. WORMER & SONS, Agents, Chicago, St. Louis & Detroit.

LECOUNT'S STRAIGHT TAIL DOG. — To be driven from a Stud in the Face Plate.

PRICES.

No. 1,	¾ in.	$ .70	No. 10,	2¼ in.,	$1.60
" 2,	⅞ "	.80	" 11,	2½ "	1.60
" 3,	1 "	.80	" 12,	3 "	1.80
" 4,	1¼ "	.95	" 13,	3½ "	2.00
" 5,	1¼ "	.95	" 14,	4 "	2.30
" 6,	1⅜ "	1.10	" 15,	4½ "	3.00
" 7,	1½ "	1.10	" 16,	5 "	3.50
" 8,	1¾ "	1.25	" 17,	5½ "	4.25
" 9,	2 "	1.40	" 18,	6 "	5.00

1 Set to 2 inches, $9.05 Full Set, $34.10

C. W. LeCOUNT, South Norwalk, Conn.

P. BLAISDELL & CO.,
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.

SHAPING MACHINES

For Hand and Power, 6", 8" and 10" Stroke.

Adapted to All Classes of Work to their Capacity.

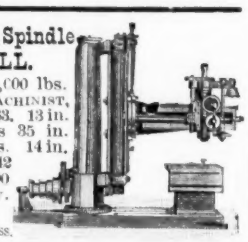
CIRCULARS FURNISHED.

BOYNTON & PLUMMER,
Worcester, Mass.

THE NEW **SOMBART** PATENT **Gas Engine**

Best motor for small powers ¼ to 1 *actual* horse power. Send for prices. SOMBART GAS ENGINE CO. Hartford, Conn. New York Office, 215 Centre St.

Five Foot Balanced Spindle RADIAL DRILL.



Shipping Weight, 6,000 lbs. Illustrated in AM. MACHINIST, issue August 18th, 1883. 13 in. stroke Shaper planes 35 in. long, weight, 3,500 lbs. 14 in. stroke Shaper planes 42 in. long. weight 4,100 lbs., are a specialty. Send for circulars.

W. H. WARREN, Worcester, Mass.

H.W.JOHNS' ASBESTOS

ASBESTOS ROPE PACKING,
ASBESTOS WICK PACKING;
ASBESTOS FLAT PACKING,
ASBESTOS SHEATHINGS,
ASBESTOS GASKETS,
ASBESTOS BUILDING FELT,

Made of strictly pure Asbestos.

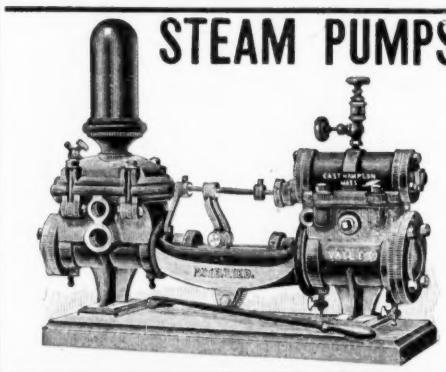
H. W. JOHNS M'F'G CO.,
87 MAIDEN LANE, NEW YORK.

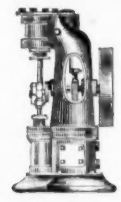
Sole Manufacturers of H. W. Johns' Genuine

ASBESTOS LIQUID PAINTS, ROOF PAINTS, ROOFING, STEAM PIPE AND BOILER COVERINGS, FIREPROOF COATINGS, CEMENTS, ETC.

Descriptive price lists and samples free.

STEAM PUMPS FOR EVERY DUTY.





Acme.

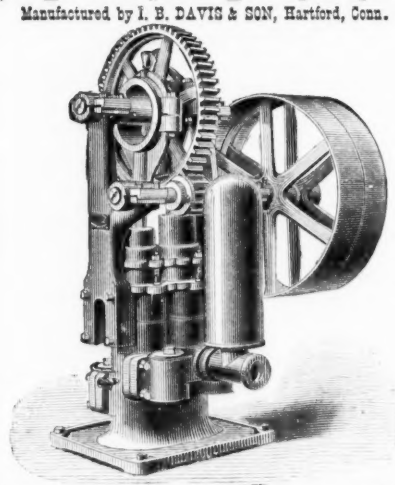
Best Boiler Feed PUMPS in the World.

Bucket Plunger.

VALLEY MACHINE CO.,
Easthampton, Mass.

The Economic Patent Boiler Feed Pump

Manufactured by I. B. DAVIS & SON, Hartford, Conn.

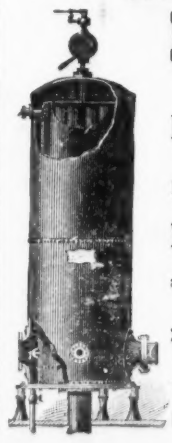


The only double-acting geared pump, geared five to one. All its parts are arranged for durability. It is made of the best material and in the most workmanlike manner. Economical in its operation. Interchangeable in all its parts. Duplicates of all the parts always kept in stock.

BENJAMIN F. KELLEY, Agent,
No. 91 Liberty St., New York

The Baragwanath Steam Jacket Feed Water Heater & Purifier.

Manufactured by the



Pacific Boiler Works,

CHICAGO, ILL.

Best Feed Water Heater IN THE WORLD.

Delivers Feed Water several degrees above Boiling Point.

Reduces Back Pressure on Engine

Prevents and Removes Scale and incrustation from Boilers.

SAVES FUEL.

Increases the Steaming Capacity of Boilers, and saves Boiler Repairs.

NEW YORK OFFICE:
111 LIBERTY STREET, Room 4.
PHILADELPHIA AGENTS,
Kensington Engine Works, Lim.
Cor. Beach and Vienna Sts.

SPECIAL TOOLS for all purposes for RAILWAY REPAIR SHOPS

CEDRICK & AYER Proprietors I. B. FLANDERS MACHINE WORKS PHILADELPHIA Send for Catalogue PA.

Buffalo Cupola & Forge Blowers.

Warranted superior to any other make.

All sizes and styles for every class of work.

BUFFALO FORGE CO.

BUFFALO, N. Y.

Send for Catalogue and prices.

AMERICAN FOUNDRY PRACTICE.

TREATING OF LOAM, DRY SAND AND GREEN SAND MOULDING, MANAGING OF CUPOLAS, AND MELTING OF IRON,

BY THOMAS D. WEST.

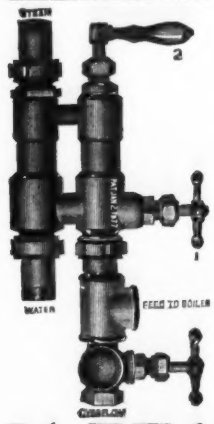
4th Edition. Fully Illustrated. 12mo, Cloth, $2.50.

John Wiley & Sons, New York.

*** Mailed and prepaid on receipt of the price.

WORTHINGTON PUMPING ENGINES AND STEAM PUMPS.

HENRY R. WORTHINGTON,
New York, Boston, Chicago, St. Louis, San Francisco.



THE HANCOCK INSPIRATOR

The Standard for Stationary, Marine, Locomotive

AND ALL CLASSES OF BOILERS.

Over 45,000 in Use.

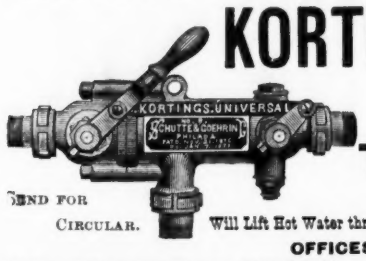
Adopted by the Largest Mills and Manufactories.

Send for Circulars to

THE HANCOCK INSPIRATOR CO.

34 BEACH STREET, BOSTON.

SCHUTTE & GOEHRING, Manufacturers.



KORTING DOUBLE TUBE INJECTOR,

THE LEADING BOILER FEEDER.

OPERATED BY ONE HANDLE.

SEND FOR CIRCULAR.

Will Lift Hot Water through Hot Suction Pipe. Guaranteed to Work under all conditions.

OFFICES AND WAREROOMS:

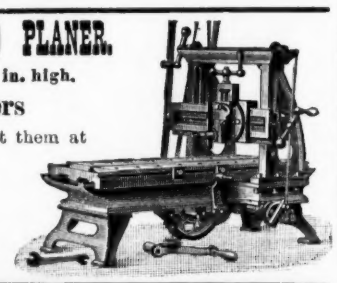
12th and Thompson Streets, Philadelphia.
JARVIS ENGINEERING CO., 7 Oliver St., Boston.
POND ENGINEERING CO., 709 Market St., St. Louis.
C. E. KENNEDY, 438 Blake St., Denver, Col.
B. R. LOMBARD & CO., 1026 Fenwick St., Augusta, Ga.
A. ALLER, 109 Liberty St., New York.
GEORGE A. SMITH, 1419 Main St., Richmond, Va
H. P. GREGORY & CO., 2 California St., San Fran'co.

TOOLS. IMPROVED POWER, OR HAND PLANER.

PLANES 27 in. long; 12 in. wide; 8 in. high.

Machinists, Engineers, Model Makers

and all classes of Mechanics can find TOOLS to suit them at



184 to 188 WASHINGTON STREET,

BOSTON, MASS.

A. J. WILKINSON & CO.

CATALOGUES FREE.

WATER.

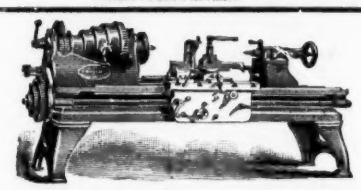
CITIES, TOWNS AND MANUFACTORIES

SUPPLIED BY GREEN AND SHAW

Patent Tube and Gang Well System,

WM. D. ANDREWS & BRO., 233 B'way, N.Y.

Infringers of above Patents will be prosecuted.



NEW HAVEN MANFG. CO.,

New Haven, Conn.

IRON - WORKING MACHINERY,

Planers, Shapers, Drills, Slotters, &c.

CRANK PLANERS.

Superior Design and Workmanship, Extra Heavy (1500 lb.)
DOWN, ANGULAR & CROSS-FEED,
TO PLANE 12x16x15.
R. A. BELDEN & CO., DANBURY, CT.

CLEM & MORSE

ELEVATORS

Hydraulic, Steam, Belt, and Hand Power,

With most approved Safety Devices such as

AUTOMATIC HATCH DOORS,
PNEUMATIC SAFETY CLUTCH, &c.

ALBRO-HINDLEY SCREW GEARING.

411 & 413 CHERRY ST., Phila.

Branch Office, 108 Liberty St. N. Y.

MACHINERY

For Reducing and Pointing Wire,

Especially adapted to pointing wire rods and wire for drawing.

For machines or information, address the manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

BLUE PROCESS PAPER —HELIOS—

In Sheets and in Rolls. Prepared and Unprepared. The best article for copying Drawings.

PARAGON & DUPLEX DRAWING PAPER.

Union Tracing Cloth,

MATHEMATICAL INSTRUMENTS, COLORS & BRUSHES,

In largest variety. Send for Circular.

KEUFFEL & ESSER, NEW YORK.

A BOLT HEAD

—AND—

NUT MILLER,

Of Original Design, for $150.

SEND FOR CIRCULAR.

Dwight Slate,

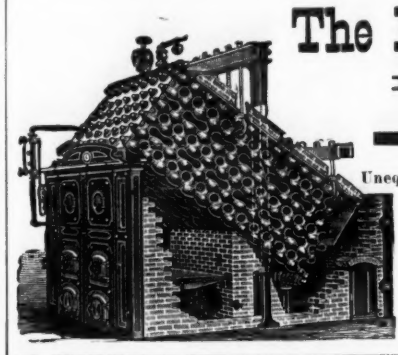
HARTFORD, CONN.

READY FOR IMMEDIATE DELIVERY AT

REDUCED PRICES

SHAPERS, 15" and 24" Stroke.
PLANERS, 10" x 2', 16" x 4', 20" x 5', 24" x 6', 26" x 6' & 8
30" x 8', 10" & 12'
HAND LATHES, 12" x 5', 15" & 18" x 6', 8' & 10' Bed. 12", 15" & 18" Slide Rests.
SHAPER AND PLANER CENTERS.
METAL SPINNING AND BUFFING LATHES.
Small Size Open Die Rivet Machines. 1 Stiles & Parker No. 4 Blanking Press, (new).

THE HENDEY MACHINE CO.,
TORRINGTON, CONN.



The Harrison Safety Boiler

For All Steam Purposes,

—THE BEST.—

Unequaled for SAFETY, DURABILITY, and the ECONOMICAL GENERATION OF DRY STEAM.

Address,

HARRISON SAFETY BOILER WORKS,

GERMANTOWN JUNC., PHILA., PA.

Or GRAYDON & DENTON MANUF'G CO., Gen, Agents, No. 1 PARK PLACE, NEW YORK.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.

JAS. HUNTER & SON, North Adams, Mass.

CLEVELAND TWIST DRILL CO.

24 & 26 West St., Cleveland, O.
101 Chambers St., New York.
Mail Building, Toronto, Canada.

W. F. HAPGOOD,

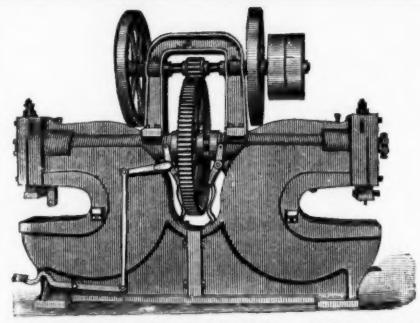
Attorney at Law,

SOLICITOR OF U. S. AND FOREIGN PATENTS.

154 NASSAU ST., NEW YORK,

(N. Y. Tribune Building.)

Every description of Patent business attended to. All questions cheerfully answered.



POWER PUNCHES, SHEARS HAMMERS.

We make over 100 sizes of Punches and Shears Double and Single, varying from 500 to 36,000 pounds in weight, and adapted for every variety of work. The Double machines are equal to two Single ones as each side is worked independently. Also

ADJUSTABLE HELVE CUSHIONED HAMMERS

Of all sizes, unequaled for efficiency and durability.

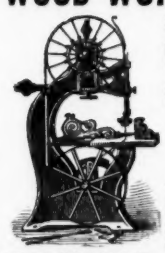
The Long & Allstatter Co.,

HAMILTON, OHIO.

J. A. FAY & CO., CINCINNATI, Ohio, U. S. A.

BUILDERS OF IMPROVED

WOOD-WORKING MACHINERY



Embraces nearly 400 Machines for

Planing & Matching,

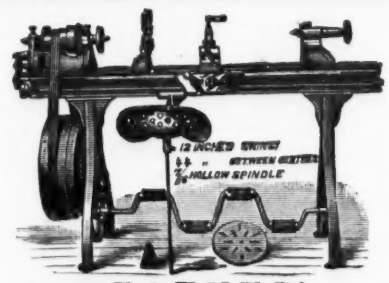
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, &c.

Variety and Universal

WOOD WORKERS.

Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.

W. H. DOANE, Pres't. D. L. LYON, Sec'y



BARNES'

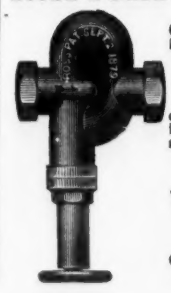
Patent Foot and Steam Power Machinery. Complete outfits for Actual Work-shop Business. Lathes for Wood or Metal. Circular Saws, Formers, Mortisers, Tenoners, etc., etc. Machines on trial if desired. Descriptive Catalogue and Price List free.

W. F. & JOHN BARNES, 1995 Main St., ROCKFORD, ILL.

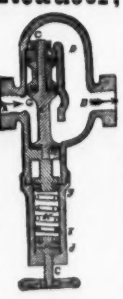
Ross Fluid Pressure Reducer,

FOR

Steam, Water, Air and Gas.

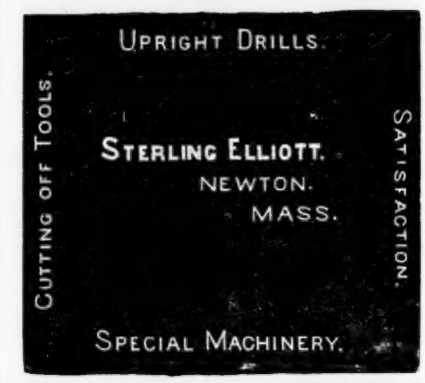


Automatically reduces the pressure in pipes to any desired extent.



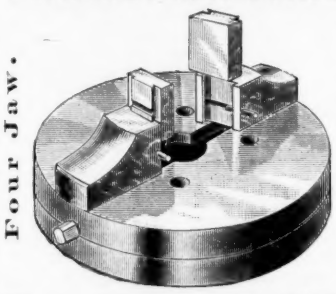
ROSS VALVE CO.

632 RIVER ST.
TROY, N. Y.



"The Horton Chuck"

Two, Three and Four Jaw.



Either Universal, Independent or the two combined.

THE E. HORTON & SON CO.

Canal St., Windsor Locks, Ct., U. S. A.

A. M. POWELL & CO.,

Worcester, Mass.,

MANUFACTURERS OF

Iron Working Machinery,

ENGINE LATHES

16 inch to 30 inch Swing.

PLANERS

To Plane 22 to 32 inches Square.

Chucking Lathes, Pulley Lathes, &c.

☞ Write for Prices and Descriptive Circular.

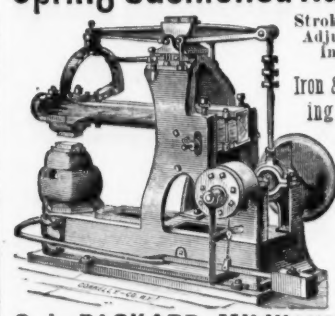
PORTABLE FORGES.

Send for Catalogue to

EMPIRE PORTABLE FORGE CO.,

COHOES, N. Y.

Spring Cushioned Hammer



Stroke can be Adjusted while in Motion.

Iron & Woodworking Machinery,

Engines,

Boilers,

and

Supplies.

O. L. PACKARD, MILWAUKEE, WIS

MORSE TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASS.

Sole Manufacturers of Morse Patent Straight-Lip Increase Twist Drill.

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.

Drills for Coes, Worcester, Hunter and other Hand Drill Presses. Drill Grinding Machines, Center and Adjustable Drill Chucks, Taper Reamers, Milling Cutters, and Special Tools to order.

All Tools Exact to Whitworth Standard Gauges.

Geo. R. STETSON, Sup't. EDWARD S. TABER, Pres't and Treas.

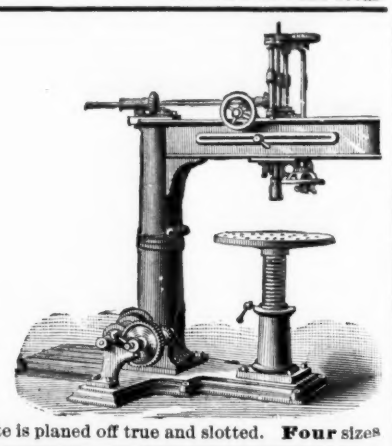
IMPROVED RADIAL DRILL,

MANUFACTURED BY

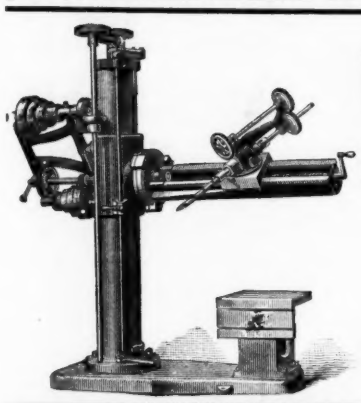
HILLES & JONES,

WILMINGTON, DEL.

THE MOST CONVENIENT DRILL FOR ALL KINDS OF WORK.



The radiating-arm traverses freely in all directions, carrying drill, spindle and gearing backward and forward by rack and pinion and hand wheels. The arm can be placed in any position, radiating from column as a center, enabling a large number of holes to be drilled in succession on the same surface without moving the work. Each machine is double back-geared, with automatic feed motion. Extension base plate is planed off true and slotted. **Four** sizes



THE

Universal Radial Drill Co.

— MAKE —

RADIAL DRILLING MACHINES

THEIR EXCLUSIVE SPECIALTY.

CORNER of 8th and SYCAMORE STS

CINCINNATI, O.

MILLING MACHINES.

BRAINARD MILLING MACHINE CO.

Works at Hyde Park, Mass.

Boston Office, 36 Oliver Street.

☞ Send for Catalogue. ☜

"ECLIPSE" HAND PIPE-CUTTING MACHINE.

Simple, Powerful, Portable, Inexpensive. With it one man can easily cut 6-inch Pipe. Made in three sizes.

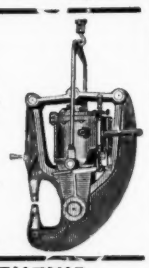
Address, for Prices, &c.,

PANCOAST & MAULE,

[Mention this Paper.] Philadelphia, Pa.

THE ALLEN PORTABLE RIVETER,

For Boiler and Tank Work, Beams and Girders.



The Allen Portable Riveting Machine Co.

No. 304 BROADWAY, N. Y.

HENRY E. ROEDER, Manager.

JOSEPH B. MATTHEWS,

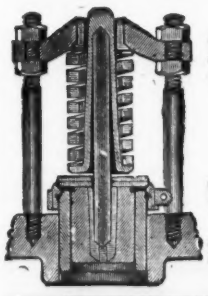
AUTOMATIC ENGINES, BALTIMORE, MARYLAND.

If You Want the Best STEAM PUMP

For Mining, Railroad or Steamboat use, Paper Mill, Chemical or Gas Works, Tannery, Brewery or Sugar Refinery, Drainage Quarries, Cellars or Plantations Irrigating or Hydraulic Mining, Sinking Foundations, Coffer Dam, Sewer, Well Sinking and other Contractors' Work, or Raising Water for any kind of Manufacturing or Fire Purpose, write for an illustrated descriptive book on the New Pulsometer, containing greatly reduced prices, hundreds of testimonials, etc. Mailed free. Prices 100 per cent. lower than others. Every pump tested before shipment and guaranteed as represented. Economy and Efficiency Unequaled. Pulsometer Steam Pump Co. 83 John St., N. Y. See prices next issue of this paper

UNION BRASS MFG. CO.

CHICAGO, ILL.



Manufacturers of

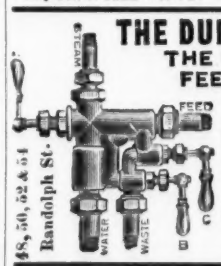
Orme's Patent LOCOMOTIVE MARINE RELIEF LOCK-UP SAFETY VALVES.

These Valves have been approved by U. S. Government.

N. Y. Office, 115 Broadway.

THE DUPLEX INJECTOR,

THE BEST BOILER FEEDER KNOWN.



Not liable to get out of order. Will lift Water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by

JAMES JENKS & CO.,

Detroit, Mich.

FORBES & CURTIS,

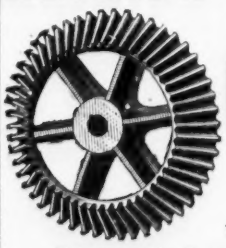
Bridgeport, Conn.

M'f'r's of

FORBES' PATENT Die Stocks,

For threading and cutting off pipe without the aid of vise. Only one man required to thread 6 in. pipe.

MACHINE MOULDED Spur and Bevel GEARS



Pulley Castings, &c.

Special Inducements to the Trade.

List mailed on application.

POOLE & HUNT,

BALTIMORE, MD.

D. SAUNDERS' SONS Yonkers, N. Y.

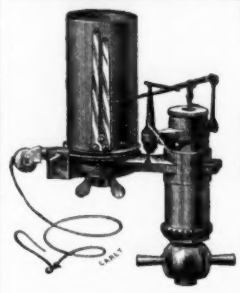
Manufacturers of

Steam and Gas Fitters' Hand Tools.

Send for Circular.

Pipe Cutting, THREADING And Tapping Machines,

THE PATENT WHEEL PIPE-CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel, hardened. Less friction of parts than any other pipe-cutter made



THOMPSON IMPROVED INDICATOR

ONE THOUSAND Now in Use.

Adopted and Used by the following Engineering Experts:

F. W. Bacon, M. E.,	John W. Hill, M. E.,
Geo. A. Barnard, M. E.,	William A. Harris,
C. H. Brown,	J. C. Hoadley, C. E.,
C. W. Copeland, C. E.,	T. W. Hugo, M. E.,
Charles E. Emery, C. E.,	J. F. Klein, M. E.,
A. M. Davy, M. E.,	Washington Jones, M. E.,
E. D. Leavitt, Jr., C. E.,	Henry Morton, C. E.,
Frank H. Pond, M. E.,	Thomas Pray, Jr., C. M. E.
Prof. R. H. Thurston,	H. W. Bulkley, M. E.

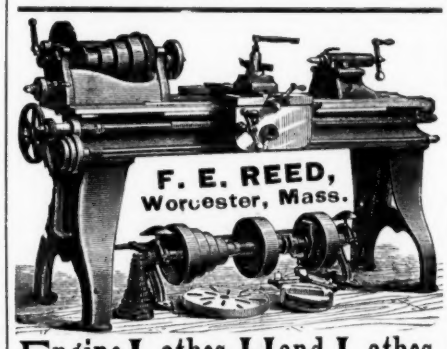
MANUFACTURED SOLELY BY THE

American Steam Gauge Comp'y,

36 CHARDON STREET,

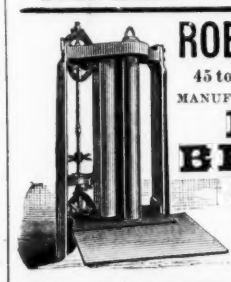
BOSTON, MASS.

Send for Illustrated Price List.



Engine Lathes, Hand Lathes,

SLIDE RESTS and PLANER CENTERS.



ROBERT KENT,

45 to 49 Jay St., B'klyn, N.Y.

MANUFACTURER OF

PLATE BENDING ROLLS.

ALSO,

Punching, Shearing, and Riveting MACHINES.

BEVEL GEARS,

Cut Theoretically Correct.

For particulars and estimates apply to

BREHMER BROS.

Machinists,

440 N. 12th Street, Philadelphia, Pa

TOOLS for Machinists, Amateurs, Jewelers, Model Makers, Blacksmiths, Carpenters, Coachmakers, etc.

Send 20 cts. for **new** Metal Worker's Catalogue, 300 Pages Wood Worker's Catalogue free.

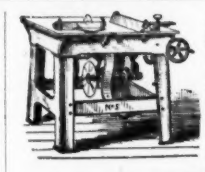
TALLMAN & McFADDEN, Philadelphia, Pa.

CRITCHLEY'S PATENT EXPANDING REAMER.

Manufactured by PORTSMOUTH MACHINE CO.

Successors to Critchley & Whalley

Send for Circular. PORTSMOUTH, N. H.



Wardwell's Patent Saw Bench, Band Saws, Rotary and Stationary Bed Planers, and Buzz Planers, Dowel Machines, Waymouth Lathes, Gauge Lathes. Also, a large stock of Second-hand Machinery, consisting of Machinists' Tools, Woodworking Machinery, and Engines and Boilers. Send for Illustrated Catalogue with stamp.

ROLLSTONE MACHINE CO.,

45 WATER STREET, FITCHBURG, MASS.

A. F. CUSHMAN CHUCKS

HARTFORD, CONN. U.S.A.

All Sizes, Independent, 4-Jaw Combination Universal Geared and Lever. Brass Finishers' 3-Jaw, from 4 in. to 9 in. Chucks for Cutting-off Lathes, Screw Machines, and Amateur Lathes. Centering and Drill Chucks.

SEND FOR CATALOGUE.

The Hoffman Lubricator.

For Stationary and Locomotive Engines. The simplest Cup made. No water column to freeze. Lock the feed and it runs itself. Address,

O. A. JENKS & CO.,

BINGHAMTON, BROOME CO.,

P. O. Box 287. NEW YORK.

WOOD WORKING MACHINERY

FOR

Planing Mills, Pattern Shops, Furniture and Chair Factories, Car and Agricultural Works, Carriage and Buggy Shops, and General Wood Workers.

Manufactured By

CORDESMAN & EGAN CO.,

Nos. 201 to 221 West Front St., Cincinnati, Ohio, U. S. A.

The Craig Double Sight Feed Lubricator Co.

LAWRENCE, MASS.

MANUFACTURERS OF THE

Craig Double Sight Feed Lubricator.

The Cheapest, Simplest and Most Complete Lubricator on the Market.

Shows the oil going up and the water coming down.

Send for Circular and Prices

S. ASHTON HAND,

Toughkenamon, Chester Co., Pa.,

MAKER OF FIRST-CLASS

ENGINE LATHES

Is now in position to put on the market

14" ENGINE LATHES OF NEW DESIGN

guaranteed to be equal in material, design and workmanship to the best ever offered.

WOOD ENGRAVING

EXECUTED IN SUPERIOR STYLE & AT SHORTEST NOTICE BY

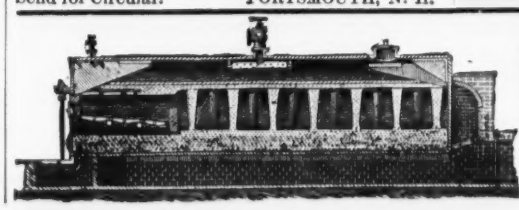
O. W. MADDAUS

23 Park Row, N.Y.

IRON AND STEEL DROP FORGING.

Of Every Description, at Reasonable Prices.

R. A. BELDEN & CO., DANBURY, CT.



THE

Galloway Boiler.

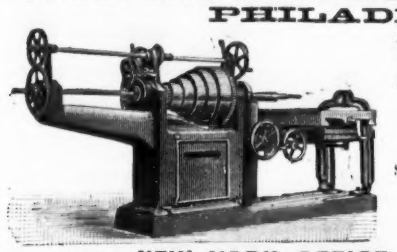
Safety—Economy in Fuel—Low Cost of Maintenance—Dry Steam without Superheating.

Correspondence solicited. Address,

Edgemoor Iron Co., Wilmington, Del.

WILLIAM SELLERS & CO.,

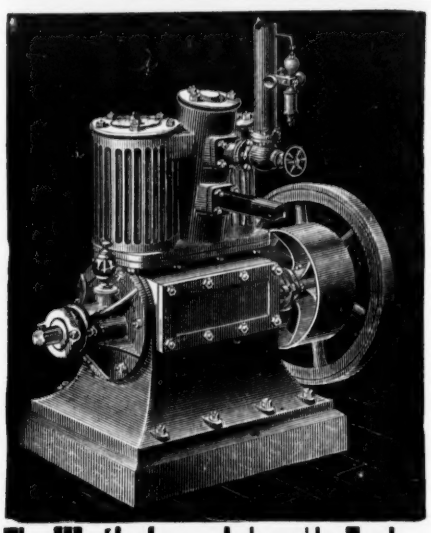
PHILADELPHIA, PA.



Machine Shop and Railway EQUIPMENTS.

Shafts, Couplings, Hangers, Pulleys, Mill Gearing, etc., Lathes, Planers, Drills, Shapers, Bolt Cutters, Railway Turntables and Pivot Bridges, Gifford Injectors, Seller's Improvements. New Patterns. Simple, Effective.

NEW YORK OFFICE, No. 79 LIBERTY STREET.



The Westinghouse Automatic Engine,

The best evidence of its peculiar merit is the fact that our

Shipments average Two Engines per day!

OVER 600 ENGINES and 16,000 H. P. NOW IN OPERATION!

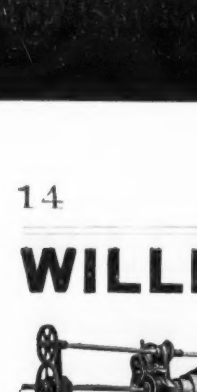
OUR PRICES ARE MODERATE.

Send for Illustrated Circular and Reference List.

THE WESTINGHOUSE MACHINE CO.

PITTSBURGH, PA.

Branch Offices: 94 Liberty Street, New York. 14 South Canal Street, Chicago. 401 Elm Street, Dallas, Texas.



CURTIS Pressure Regulator

For Steam, Water and Air,

MANUFACTURED BY

Curtis Regulator Co.

51 BEVERLY ST.,

Boston, - - Mass.

GENERAL AGENCIES:

109 Liberty St., New York.
925 Market St., Phila., Pa.
80 Market St., Chicago, Ill.
Cor. Holliday and Saratoga Streets, Baltimore.

W. C. YOUNG & CO., Worcester, Mass.

MANUFACTURERS OF

ENGINE LATHES, HAND LATHES,

Foot Power Lathes, Slide Rests, &c.

FILE TRUING DEVICE.

Designed expressly for nice machinists' work. By its use an absolutely level surface can be obtained with very little trouble. Size of File Block, 2¼" wide, 10" long, ¾" thick.

KEARNEY & FOOT, 101 Chambers St., N. Y.

C. WING, GREENFIELD, MASS.

—DESIGNER—

And Manufacturer of

Special Machinery and Tools, also improved Hand and Wood Turning Lathes. Circulars now ready.

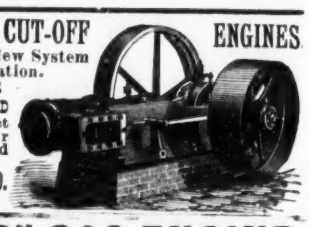
AUTOMATIC CUT-OFF ENGINES

Embodying a New System of Regulation.

THE GOVERNOR WEIGHS the LOAD

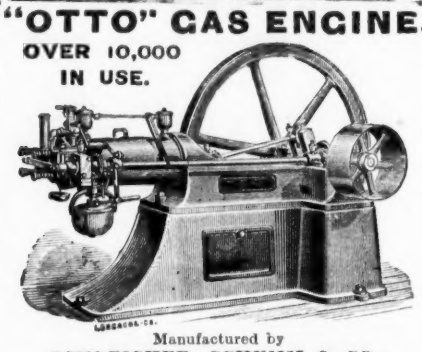
The most perfect governing ever obtained. Send for circular A.

BALL ENGINE CO. ERIE, PA.



"OTTO" GAS ENGINE.

OVER 10,000 IN USE.



Manufactured by

SCHLEICHER, SCHUMM & CO., 33d and Walnut Streets, Philadelphia.

FOR LAGGING STEAM ENGINE

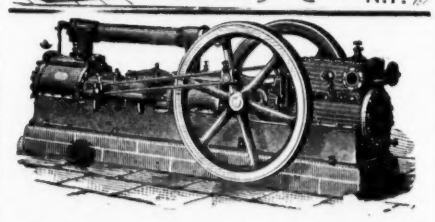
CYLINDERS

Use Fireproof and Indestructible

MINERAL WOOL.

Sample and Circular free by mail

U. S. MINERAL WOOL CO., 22 Cortland St., N. Y.



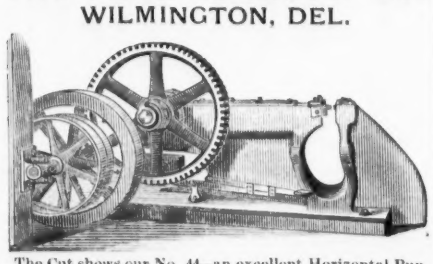
STEAM PUMPS, AIR COMPRESSORS, Friction Hoisting Engines, Vacuum Pumps and Condensers, General Machinery, Steam Engines. Capacity to bore cylinders 110 in. diameter and turn Fly Wheels of 24 feet.

The Norwalk Iron Works Co.,

SOUTH NORWALK CONN.

THE PUSEY & JONES CO.

WILMINGTON, DEL.



The Cut shows our No. 44—an excellent Horizontal Punching Machine, making a one-inch diameter Hole through one-inch iron, and also useful for punching stay-bolt holes in furnace sheets after the sheets have been fitted.

BUILDERS OF STEAM ENGINES,

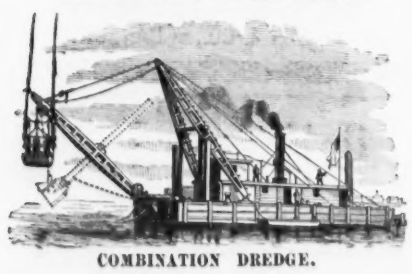
Boilers, Tanks, Machinery for Rolling Mills, Punches, Shears, Riveters, Angle Iron Cutters, Cranes and heavy Iron Work generally.

DREDGES

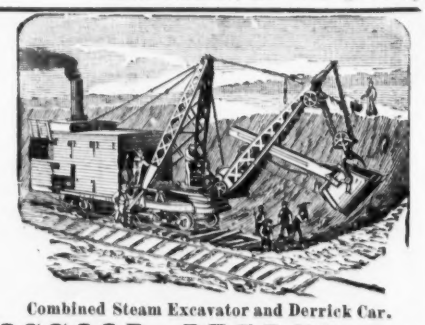
guaranteed to excavate 50 per cent. more material from hard bottom than any other machine.

EXCAVATOR

has a capacity of 6 cubic yards per minute in gravel. Very efficient and durable in the hardest hard-pan. Derrick lifts 8 tons. Circulars furnished.



COMBINATION DREDGE.



Combined Steam Excavator and Derrick Car.

OSGOOD DREDGE CO

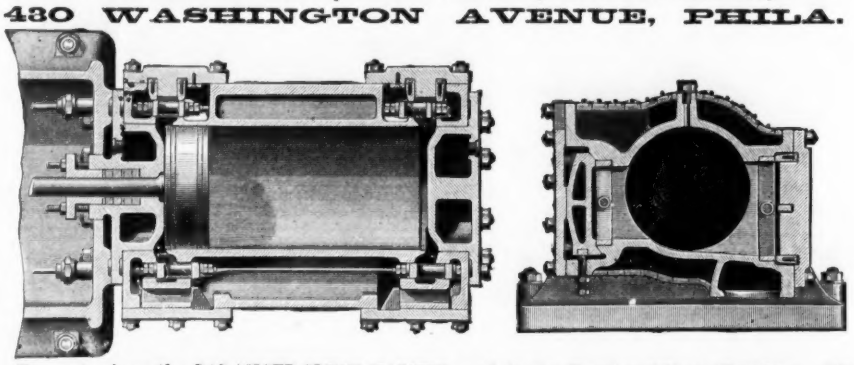
ALBANY, N. Y.

RALPH R. OSGOOD, President,
JAMES MACNAUGHTON, Vice-President,
JOHN K. ROWE, Secretary and Treasurer.

PORTER-ALLEN HIGH SPEED ENGINE.

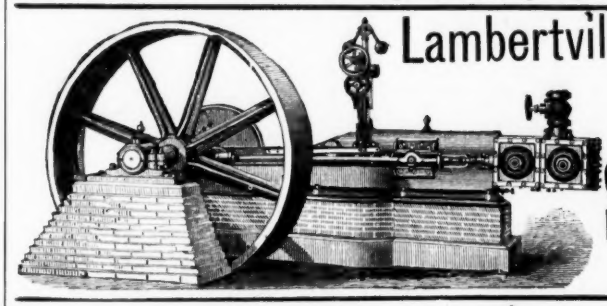
The Southwark Foundry and Machine Co., Sole Manufacturers,

430 WASHINGTON AVENUE, PHILA.



The cuts show the BALANCED-SLIDE VALVES used in the **Porter-Allen Engine.** The provisions for taking up wear enable the Valves to be kept perfectly steam-tight. These and the other features connected with the Engine will be found fully explained in a handsomely illustrated new work on High Speed Engines recently issued by us for FREE DISTRIBUTION among engineers and manufacturers. It has excited such an interest among scientific men and engineers as to call for another edition.

Four Porter-Allen Engines have been working constantly (part of the time day and night) for 17 years, at COLT'S ARMORY, and are now pronounced as good as new.



Lambertville Iron Works,

MANUFACTURERS OF

PATENT AUTOMATIC CUT-OFF

Steam Engines

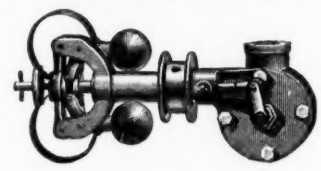
LAMBERTVILLE, N. J.

WRIGHT MACHINE CO.

WORCESTER, MASS.,

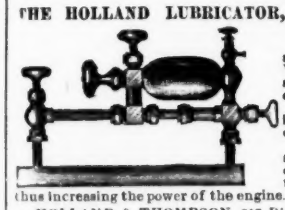
Manufacturers of

STEAM ENGINE GOVERNORS,



WATER WHEEL GOVERNORS.

THE HOLLAND LUBRICATOR, VISIBLE DROP,



Is guaranteed to be 1. A perfect insurance against the cutting of Valve-seats, Cylinder and Governor Valves of the engine. 2. It will pay for itself in 6 months in saving of oil, coal, and packing. 3. It will insure more speed in the revolutions of the engine, say from 1 to 2 strokes per minute, thus increasing the power of the engine. Manufactured by

HOLLAND & THOMPSON, 217 River St., Troy, N. Y

FOR SALE.

PLANER,

SHAPER,

PULLEY BORER,

PULLEY TURNER,

Chuck Lathe, with Milling Head; several Engine Lathes and Drills.

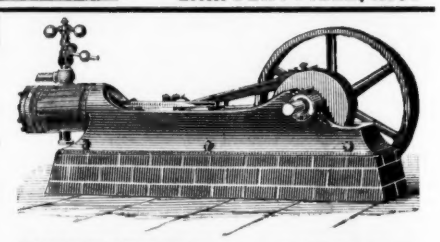
The above are SECOND-HAND TOOLS, very little used, and in good condition, of standard makes, with latest improvements, &c. Will be sold cheap. For description, price, &c., address,

H. BICKFORD,

CINCINNATI, Ohio.

PECK'S PAT. DROP PRESS. NEW HAVEN BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL BEECHER & PECK, NEW HAVEN CONN.



SKINNER & WOOD

ERIE, PA.

Are prepared to fill orders for their

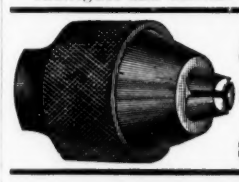
NEW AND IMPROVED

STATIONARY ENGINES

for all purposes from 25 to 40 Horse-power, together with any style of boiler preferred. This Engine is fitted with heavy counterbalanced Crank and Automatic Stop Governor.

PORTABLE ENGINES, with **Return Flue Boilers,** also a specialty.

Catalogues and estimates cheerfully given.

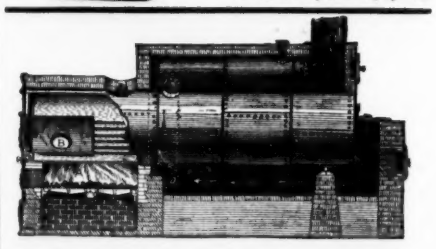


Almond Drill Chuck.

Sold at all Machinists' Supply Stores.

T. R. ALMOND,

84 Pearl St., Brooklyn, N.Y



BRIDGEPORT BOILER WORKS,

BRIDGEPORT, CONN.

LOWE & WATSON, Proprietors,

MANUFACTURERS OF

The Lowe Patent Tubular Boiler, with and without Superheating Drums. Fourteen years' use proves them the most durable and reliable boiler known. Gives dry steam. The process for combustion of the gases is in the construction and setting. Burns any fuel; obtains as much result from it as any boiler or setting with no more cost, and greater durability.

Send for descriptive Circular.

WM. B. BEMENT & SON, Phila., Pa.,

MANUFACTURERS OF

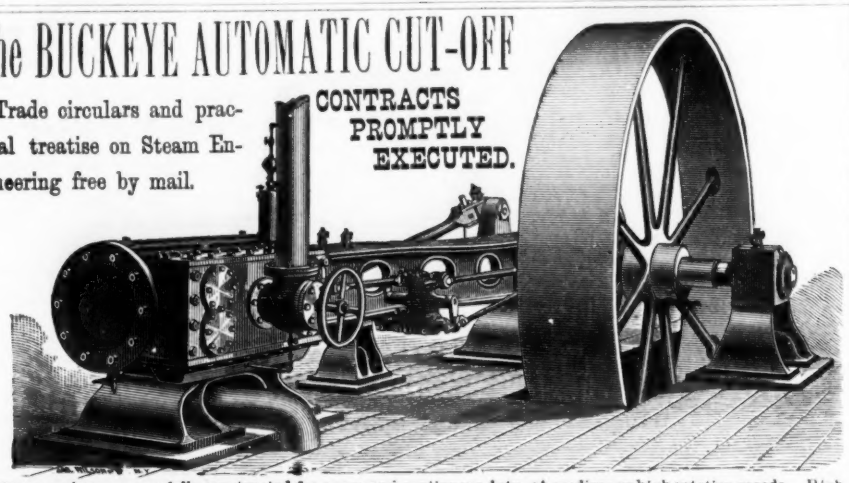
METAL WORKING MACHINE TOOLS.

As we are equipping our shops with New Machinery, we are offering for sale, at special prices, a line of Second Hand Tools, nearly all of our own make, which have been in use by ourselves, and have been kept in careful repair. Send for circular.

The BUCKEYE AUTOMATIC CUT-OFF

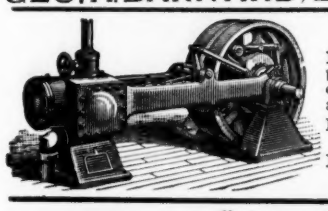
Trade circulars and practical treatise on Steam Engineering free by mail.

CONTRACTS PROMPTLY EXECUTED.



These engines are carefully constructed for heavy and continuous duty, at medium or high rotative speeds. Highest attainable economy in consumption of steam, and superior regulation guaranteed

Address BUCKEYE ENGINE CO., Salem, Ohio; or
GEO. A. BARNARD, Eastern Sales Agt., Astor House, N.Y.

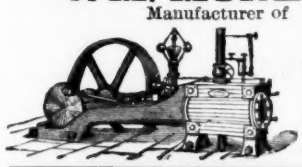


STRAIGHT LINE AUTOMATIC CUT-OFF ENGINE;

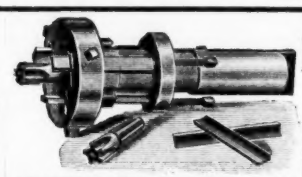
Medium or high speed; uniform at all ranges of power or steam pressure; the fewest parts and working joints; the best material correctly distributed, and unexcelled in workmanship, balance, and smooth running.

For Eastern and Southern States, apply to the
Straight Line Engine Co., Syracuse, N. Y.
For the West and South-West, to the
M. C. Bullock Manufacturing Co., Chicago, Ill.

WM. MÜNZER,
Manufacturer of



IMPROVED CORLISS ENGINE.
1st Av. cor. 30th St.
New York.



JEWEL FLUE HOLE CUTTERS,
With Renewable Cutters. Kept sharp by grinding on end.
MYERS MFG. CO., CHICAGO, ILL.

THE NEW ROOT SECTIONAL BOILER

SAFETY, ECONOMY, DURABILITY.

Rapid Generation of Dry Steam

THE BEST in every respect for all steam purposes.

Send for Illustrated Catalogue to

ABENDROTH & ROOT MFG. CO
28 CLIFF ST., NEW YORK.

First-Class, Heavy, Double and Treble Geared

ENGINE LATHES

HORIZONTAL BORING LATHES, FOX LATHES, LIFTING JACKS and CORNICE MACHINERY,

GEO. A. OHL & CO., East Newark, N. J.

SCHUTTE & GOEHRING, MANUFACTURERS,

The Korting Exhaust Steam Induction CONDENSER.

For Steam Engines and Pumps. No foundations or hot wells. Will lift water supply without any pump; also operates under one foot fall of water.

OFFICES AND WAREROOMS:
12th & Thompson Sts., Phila. | A. Aller, 109 Liberty St., N.Y. | Jarvis Eng. Co., 7 Oliver St., Boston.

VOLNEY W. MASON & CO.
Friction Pulleys, Clutches and Elevators
PROVIDENCE, R. I.

SECOND-HAND MACHINERY,
CHEAP.

15 in. x 6 ft.	Engine Lathe.	Watts, Campbell & Co.
15 in. x 8 ft.	" "	Pratt & Whitney.
15 in. x 8 ft.	" "	Fitchburg Machine Co.
17 in. x 8 ft.	" "	Lincoln.
18 in. x 8 ft.	" "	Lathe & Morse.
25 in. Drill Bk. Gear & S. F.		Fitchburg Mach. Co.
32 in. x 32 in. x 10 ft.	Planer.	Pond.
28 in. x 28 in. x 7 ft.	Planer.	New Haven.
36 in. x 36 in. x 12 ft	Planer.	Niles. A 1.
Two 4 Spindle, No. 2 Drills, P. & W.		
One 2 " " 0 "		
One Sellers Twist Drill Grinder.		
One No. 2 Screw Machine, P. & W.		

NEW MACHINERY.

13, 16, 20, 24, 30, 42 inch swing Engine Lathes Ames.
16 in. x 6, 7, 8, 10 and 12 ft. Engine Lathes. Bridgeport.
18 in., 20 & 24 in. swing. Engine Lathes. Fifield

DRILLS

16, 18, 20, 22, 26, 30 in. x 36 in. Prentice. New.
Slate Sensitive. "

PLANERS.

16 in. x 16 in. x 42 in. Bridgeport. New.
22 in. x 22 in. x 5 ft. Ames. "
24in. x 27 in. x 6, 7 and 8 ft. "
27 in. x 27 in. x 6, 7 and 8 ft.
9 in. Hewes & Phillips' Shapers. New.
15 in. x 24 in. Hendey Shapers. "
8, 10, 15, 20 and 25 in. Gould & Eberhardt Shapers. "
No. 2 Lincoln Pattern Milling Machine. Ames. New
No. 2 Screw Machine. wire feed. Secor. New.
Bridgeport Mch. Tool Wks. New 37 in. Boring and Turning Mill ready for delivery.
One Travelling Head Shaper, 12 in. Stroke, Double Table.

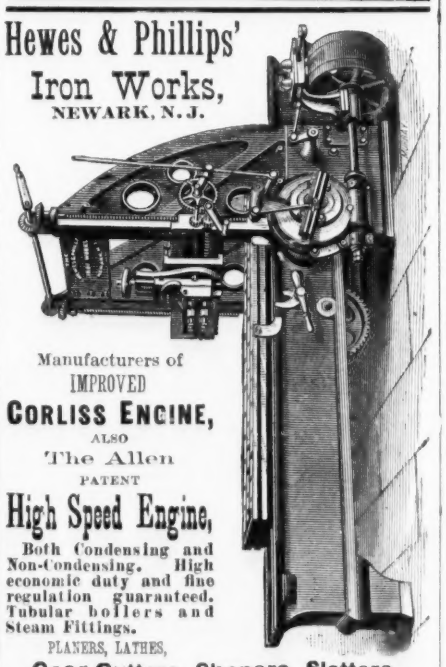
NEW YORK AGENTS:
Brown & Sharpe Manufacturing Co.
Bradley's Cushion Hammer.
National Mchy. Co. Bolt and Nut Mchy.
Hilles & Jones, Boiler Tools.

Write full particulars of what is wanted.

E P. BULLARD. 14 DEY ST., N Y.

RUBBER STAMP MAKERS TOOLS & SUPPLIES BARNES & ALLEN SYRACUSE, N.Y.

Hewes & Phillips' Iron Works,
NEWARK, N. J.



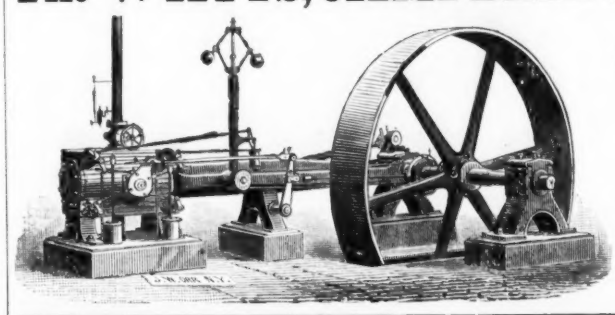
Manufacturers of
IMPROVED
CORLISS ENGINE,
ALSO
The Allen
PATENT
High Speed Engine,

Both Condensing and Non-Condensing. High economic duty and fine regulation guaranteed. Tubular boilers and Steam Fittings.

PLANERS, LATHES,
Gear Cutters, Shapers, Slotters,
Also Hydraulic Oil Presses, and Veneer Cutting Machinery, Shafting and Gearing.

HEAVY PLANERS A SPECIALTY.

The WATTS, CAMPBELL CO. NEWARK, N. J.



MANUFACTURERS OF
Improved Corliss STEAM ENGINES
In Full Variety.
Sizes varying from 30 to 2000 H.P.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.

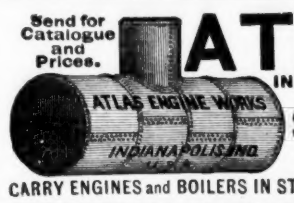
Close Regulation, Best Economy, Simplicity of Valve Gear, and Low Prices, are features of

THE DEXTER AUTOMATIC CUT-OFF ENGINE.

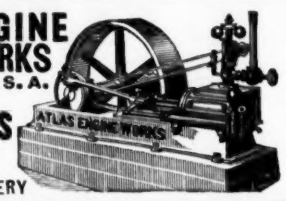
STANDARD SIZES ON HAND OR QUICK DELIVERY.
SEND FOR CATALOGUE A.

DEXTER ENGINE CO., 40 CORTLANDT STREET, NEW YORK.

Send for Catalogue and Prices.



ATLAS ENGINE WORKS
INDIANAPOLIS, IND., U. S. A.
MANUFACTURERS OF
STEAM ENGINES AND BOILERS.



CARRY ENGINES and BOILERS IN STOCK for IMMEDIATE DELIVERY

JUST PUBLISHED.

MONCKTON'S PRACTICAL GEOMETRY

Being a series of lessons beginning with the simplest problems, and in the course embracing all of Geometry likely to be required for the use of every class of mechanics, or that are needed for instruction in mechanical schools.

Illustrated by 42 Full Page Plates.

By JAS. H. MONCKTON,

Author of Monckton's "National Carpenter and Joiner," and Monckton's "National Stair Builder."

Instructor for many years in "The Mechanics and Traders Free Drawing School," of the City of New York

One 12mo volume. Cloth. Price, post-pid, $1.00.

WILLIAM T. COMSTOCK, 6 ASTOR PLACE, NEW YORK.

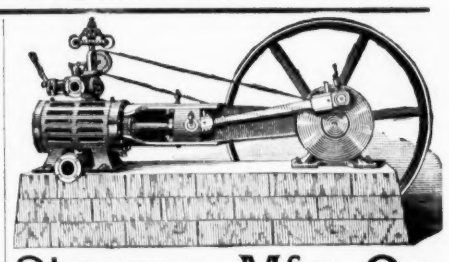
CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

THE BABCOCK & WILCOX CO.
WATER TUBE STEAM BOILERS,

107 Hope St. GLASGOW. | 30 Cortlandt St. NEW YORK.

BRANCH OFFICES.
BOSTON: 50 Oliver Street.
PHILADA: 32 N. 5th Street.
PITTSBURGH: 91 4th Ave.
CHICAGO: 64 S. Canal St.
NEW ORLEANS: 54 Carondelet St.
SAN FRANCISCO: 50 S. Mission St.
HAVANA, 50 San Ignacio.

Send to nearest office for circular.



Stearns Mfg. Co.
ERIE, PA.

Engines from 15 to 400 Horse Power,

Boilers of Steel and Iron

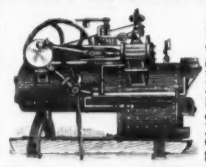
Supplied to the trade or the user. Send for catalogues.

Saw Mills & General Machinery,

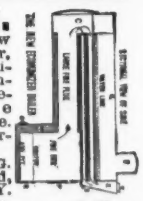
WORKS AT ERIE, PA.

BINDERS FOR THE AMERICAN MACHINIST, $1.00 BY MAIL.
96 FULTON STREET, N. Y.

PORTER MANUF'G CO.



The New Economizer, the only Agricultural Engine with Return Flue Boiler in use. Send for circular to PORTER MFG. Co., Limited, Syracuse, N.Y.



Stationary and Portable Boilers and Engines. Iron and Steel Boilers. Power and Steam Pumps.

NEW ECONOMIZER BOILER a Specialty

SECOND-HAND MACHINERY.

We have the following second-hand Machinery for sale, viz:

One Planer, to plane 60 in. x 60 in. x 21 ft. long. Bement's make.

One Iron Planer, to plane 12 feet long, 36 in. x 32 in., in fair condition.

One Planer, to plane 17 ft. long, 50 ft. x 50 ft.

One Iron Planer, to plane 9 ft. long, 36x36 in.

One Iron Planer, to plane 8 ft. long, 30x30 in.

One Iron Planer, to plane 7 ft. long, 30x30 in.

Two Iron Planers, to plane 6 feet x28x28 inch.

Two Iron Planers, to plane 4 feet x20x20 inch.

One Iron Planer, to plane 8 feet x27x27 inch.

One 36 in. Car Wheel Borer, very good order.

One Engine Lathe, 12 foot bed 30 inch swing.

One Slotting Machine, 12 in. stroke, slots to the center of 46 in. Adjustable table and universal feed motion.

One Car Axle Lathe, Fitchburg Machine Co.

One 7 in. Shaper, Lowell Machine Shop.

Send for List of Machinery.

The George Place Machinery Co.,
121 CHAMBERS & 103 READE STS., NEW YORK.

New & Second-Hand Machinery,

NEW.

1 Engine Lathe, 10 in. x 3½ ft.
1 each, Engine Lathes, 11 in. x 4 and 5 ft.
1 each, " " 13 in. x 5, 6 and 8 ft.
1 Engine Lathe, 14 in. x 5, 6 and 8 ft.
1 " " 16 in. x 6 ft.
1 each, Engine Lathes, 16 in. x 6, 7, 8 and 10 ft.
1 Engine Lathe, 18 in. x 6, 8, 10 and 12 ft,
1 " " 20 in. x 8, 10, 12, 14 and 16 ft.
1 " " 22 in. x 8, 10, 12, 14 and 16 ft.
1 " " 24 in., any length of bed to 26 ft.
1 " " 26 in., " " 26 ft.
1 " " 28 in., " " 46 ft.
1 " " 28 in., " " 28 ft.
1 " " 30 in., " " 28 ft.
1 " " 36 in., " " 29 ft.
1 " " 42 in., " " 28 ft.
1 " " 48 in., " " 29 ft.
1 " " 15 in., x 4,6 and 8 ft. Rod feed only.
1 each, Turret Lathes, 13 and 14 in. x 14 in. x 6 ft.
1 Fox Turret Lathe, 16 in. x 6 ft.
1 Fox Lathe, 15 in. x 5 ft. Round Arbor.
1 each, Hand Lathes, 10, 12, 15 and 18 in. swing.
1 Iron Planer, 18 in. x 18 in. x 3 ft.
1 each, Iron Planers, 20 in. x 20 in. x 4 and 5 ft.
1 Iron Planer, 24 x 24 x 6 ft.
1 each, Iron Planers, 26 in. x 26 in. x 7 and 10 ft.
1 Iron Planer, 30 x 30 in. x 10 ft.
1 " " 36 in. x 36 in. x 10 ft.
1 each, 16, 20, 22, 23, 25, 28, 30, 34 and 38 in. Upright Drills.
1 each, Nos. 2, 3, 4 and 6 Spindle Gang Drills,
1 each, 8, 10, 12, 15, 18 and 24 in. Shapers.
1 each, 1, 2, 3 and 4 Milling Machines.
1 No. 2 Milling Machine. Lincoln Pattern.
1 New Pattern Milling Machine. Grant & Bogert.
1 each, Nos. 2, 4, 5 Wire Feed Screw Machines.
1 each, Nos. 3 and 7 Spindle Nut Tapper.
1 Boring and Turning Mill, each 50 and 72 in.
1 Gray's Screw Machine, to take all sizes to 1 in.
1 26 in. Gear Cutter.
1 Grant & Bogert Cutter Grinder.

SECOND-HAND.

1 Engine Lathe 14" x 4½ feet. "A 1" order.
1 Engine Lathe, 16 in. x 6 ft.
1 Engine Lathe, 20 in. x 8 ft.
1 Engine Lathe, 26 in x 18 ft
1 Planer, 24 x 24 x 5 ft.
1 " 36 x 36 x 10 ft.
1 " 18 x 18 and 3 ft.
1 11 in. Shaper.
1 2-Spindle Edging Machine.
2 Lincoln Pattern No. 2 Millers.
1 Bolt Cutter, to take sizes to 1 inch.

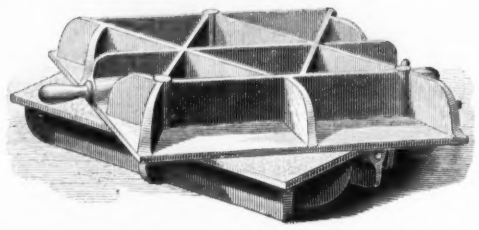
All Kinds Machinist's Tools and Supplies.
NEW YORK AGENCY OF THE TANITE CO., GRANT & BOGERT MACHINE TOOL WORKS, AND FOR THE NEW POLISHED SHAFTING.

H. PRENTISS & CO., 42 Dey St., N. Y.

BROWN & SHARPE MF'G. CO.,

Manufacturers of Machinery and Tools,

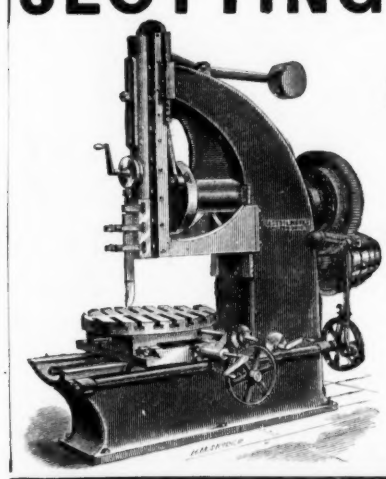
PROVIDENCE, R. I.



SIZES AND PRICES OF SURFACE PLATES.

4½ in. x 6 in. $ 5.00	9 in. x 9 in. $12.00	12 in. x 12 in. $22.00	16 in. x 16 in. $40.00
6 in. x 6 in. 6.00	9 in. x 14 in. 19.00	12 in. x 18 in. 33.00	18 in. x 18 in. 48.00
6 in. x 12 in. 11.00	10 in. x 15 in. 25.00	14 in. x 14 in. 30.00	18 in. x 36 in. 65.00
6½ in. x 18 in. 18.00	10 in. x 30 in. 45.00	14 in. x 18 in. 37.00	24 in. x 24 in. 88.00

SLOTTING MACHINES,



9 in., 13 in. and 18 in. Stroke. New Patterns.

RAM CUIDE ADJUSTABLE VERTICALLY.

Feeds always take place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS,

HAMILTON, OHIO.

BRANCH OFFICES:

PHILADELPHIA, 22 South Sixth Street.

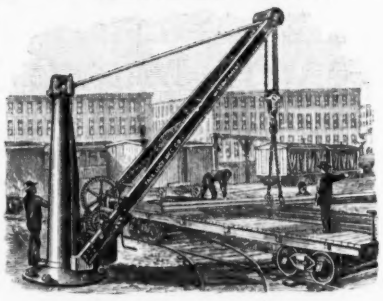
CHICAGO, 153 Lake Street.

WESTON'S PATENT SAFETY

PILLAR CRANES,

ANY CAPACITY.

Load Always "Self-Sustained."



Specification and Tender promptly submitted on receipt of Capacity, Height of Hoist, and Effective Radius desired.

STANDARD SIZES IN STOCK.

THE YALE & TOWNE MFG. CO.,

STAMFORD, CONN.

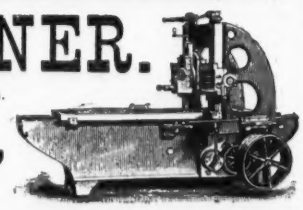
NEW YORK, 62 READE STREET. | **BOSTON,** 224 FRANKLIN ST. | **PHILADELPHIA,** 15 N. SIXTH ST. | **CHICAGO,** 64 LAKE ST.

CATALOGUES ON APPLICATION.

THE GRAY PLANER.

26 in. x 26 in. x 6⅛ ft, wt. 7,000 lbs. 26 in. x 26 in. x 8½ ft., wt. 8,200 lbs.

New Descriptive Circular now ready.



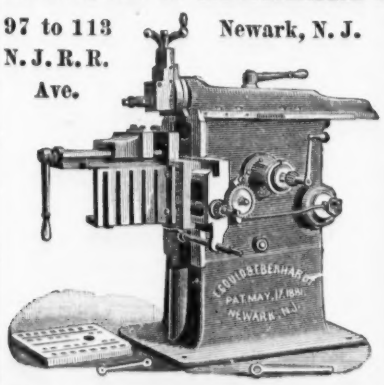
G. A. GRAY, Jr. & CO.,

COR. 8TH AND SYCAMORE STS.,

CINCINNATI, OHIO.

E. GOULD & EBERHARDT

97 to 113 N. J. R. R. Ave. Newark, N. J.



Patent Shapers

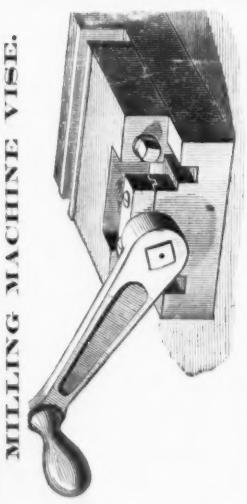
QUICK Adjustable Stroke.

Can be CHANGED while in MOTION.

E. E. GARVIN & CO.

139 & 141 Centre St., New York,

MILLING MACHINE VISE.



Manufacturers of

Machinists' TOOLS,

INCLUDING

MILLING MACHINES, DRILL PRESSES, HAND LATHES, &c.

We make three sizes of this Vise, with steel jaws and screws. Screw and cap covered with sheet steel to prevent wear from dust and dirt.

Send for Catalogue.

THE PRATT & WHITNEY CO., HARTFORD, CONN.

Have Ready for Delivery:

Drilling Machines—No. 2 Upright, No. 3 Vertical; Nos. 2 and 3, Manufacturer's; Nos. 1 & 3 Manufacturer's Bench; Champion Drills; No. 0, 1 & 2 Gang Drills, 10 in. Pillar Shapers. 1, 14 in. Shaping Machine; Hand Lathes, 8, 12, 15 and 18 in swing; Cutting-off Lathes for 2½ and 4½ in. diameter. Revolving Head Screw Machines, Nos. 1, 2, 3 and 4; Hand Milling Machines, Nos. 1, 2 and 3; Power Milling Machine, Nos. 1, 2, 3 and 4; Bolt Cutters, Turret Head, Nos. 2, 3 and 4; National, Nos. 2, 3 and 4. Nos. 1 and 2 Screw Shaving Machines; No. 1 and 2 Screw Slotting Machines; 13 in. Plain Engine Lathes; 13 and 16 in. Weighted 16, 19 and 21 in. Gibbed Screw Cutting Lathes. One Double Connection Power Press. Index Milling Machines. Nos. 2 and 3 Horizontal Tapping Machines. Cutter Grinders. 16, 18, 20, 24, 26, 34 and 40 in. Planers. No. 1 Die Sinker; 10 and 18 in. Lead Lapping Machines; 18 and 38 in. Chucking Machines; Nut Tapping Machines. **Have increased discount on Combination Lathe Chucks;** quotations on application.

DROP FORGINGS

BILLINGS & SPENCER CO. HARTFORD, CONN. U.S.A.

ALSO

Billings' Patent Adjustable Pocket Wrenches, 4 AND 6 INCHES.

FINISHED SCREW PLATES AND DIES, GENUINE PACKER RATCHET DRILLS, BILLINGS' PATENT DOUBLE ACTION RATCHET DRILLS, TAP & REAMER WRENCHES,

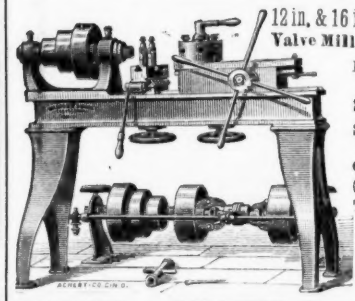
CLAMP, DIE & COMMON LATHE DOGS, COMBINATION PLIERS, BEACH'S PATENT THREAD-CUTTING TOOLS, BARWICK PIPE WRENCHES.

Billings' Patent Drop Forged & Cold-Pressed Sewing Machine Shuttles

AND ALL DESCRIPTIONS OF

STEEL AND IRON DROP FORGINGS.

BRASS WORKING MACHINERY.



12 in. & 16 in. Monitors
Valve Milling Mach's
Double Key Lathes,
Speed Lathes
Slide Rests,
Revolving Chucks for Globe Valves,
Two-Jawed Chucks,
Small Tools and Fixtures.

WARNER & SWASEY, Cleveland, O.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application. **Lowell, Mass., U. S. A.**

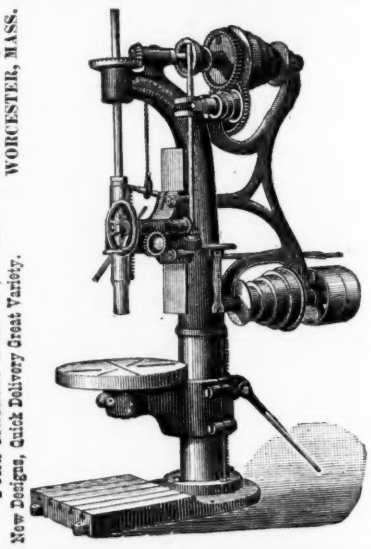
ROP HAMMERS

Punching Presses
DIES AND OTHER TOOLS
For the manufacture of all kinds of SHEET METAL GOODS, DROP FORGINGS, &c.
Stiles & Parker Press Co.

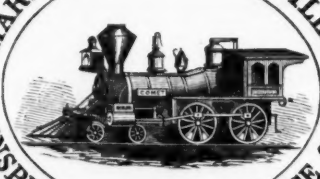
Engine Lathes, Planers, Drills, &c.

Pond Machine Tool Co., Successors to David W. Pond, WORCESTER, MASS.

New Designs, Quick Delivery, Great Variety.



HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.



J. M. ALLEN, President.

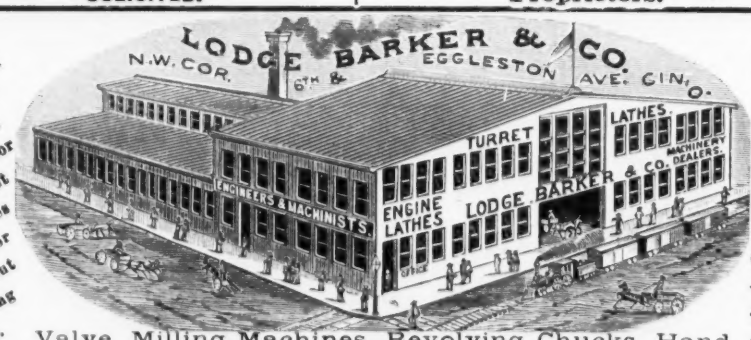
W. B. FRANKLIN, Vice-President.

J. B. Pierce, Secretary.

THE BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.

ORDERS AND CORRESPONDENCE SOLICITED. | PRATT & LETCHWORTH, Proprietors.

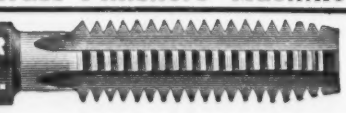
14 in. and 16 in. Monitor Turret Lathes with or without Chasing Bars.


LODGE BARKER & CO.
N.W. COR. 6TH & EGGLESTON AVE. CIN'O.
ENGINEERS & MACHINISTS
ENGINE LATHES
TURRET LATHES
LODGE, BARKER & CO. MACHINERY DEALERS

18 in. 24 in. and 26 in. Engine Lathes and Turret Chuck'g Lathes always on hand.

Valve Milling Machines, Revolving Chucks, Hand Speed Lathes with dove tail set over, and a full line of Brass Finishers' Machinery.

J. M. CARPENTER PAWTUCKET, R. I.



MANUFACTURER OF

TAPS & DIES.